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The Support of Research in the Bio-Sciences for the Fiscal Years 1952 and 1953

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THIS report presents a summary of certain funds awarded for research in the bio-sciences during two fiscal years, 1952 and 1953, each of which begins on July 1 and ends on June 30. It follows and supplements "The support of research in medical and allied fields for the period 1946 through 1951" (*1*) and is designed for comparison with that study.

TABLE 1. Support of investigative research in the bio-sciences, fiscal years 1950, 1952, and 1953.

	1950			1952			1953		
	No. of grants	Amounts	Percentage of amount	No. of grants	Amounts	Percentage of amount	No. of grants	Amounts	Percentage of amount
Total	3317	33,000,870	100	4269	48,186,562	100	4933	55,995,286	100
Government	2052	21,320,493	65	3022	34,533,220	72	3558	40,234,918	72
Nongovernment	1265	11,680,377	35	1247	13,653,342	28	1375	15,760,368	28

TABLE 2. Percentage increases in grants and amounts.

	1952 increase over 1950		1953 increase over 1950	
	Grants	Amounts	Grants	Amounts
Total	29	46	49	70
Government	41	62	73	89
Nongovernment	− 1	17	9	35

The data upon which this report is based are the funds awarded for nonsecurity classified grant (*2*) and contract research in the bio-sciences by seven government agencies (Atomic Energy Commission, Department of the Air Force, Department of the Army, Department of the Navy, National Science Foundation, Public Health Service, and Veterans Administration) and the funds awarded by the national offices of major fund-raising organizations and by the private foundations that make awards on a nation-wide scale. Our records for these agencies are essentially complete, and the funds, therefore, represent those available for investigative research from national sources, exclusive of industry.

It should be clearly understood that the funds used in this report do not represent the total cost of research in the bio-sciences. They are the funds awarded on a project basis by the agencies listed in the foregoing paragraph, and they do not include the cost of this research to the institutions in which the work is conducted. No funds for the care and rehabilitation of patients (for which money from fund-raising organizations is often allocated), for fellowships, for control programs, or for construction programs are included. Thus, this report is based upon a discrete body of data comprised of a definite number of grants in known amounts awarded during each fiscal year.

TABLE 3. Annual percentage changes in grants and amounts awarded, all sources, 1950–1953.

	1950		1951		1952		1953	
	Grants	Amounts	Grants	Amounts	Grants	Amounts	Grants	Amounts
All agencies	18	0	17	26	10	16	16	16
Government	42	10	26	37	17	18	18	17
Nongovernment	− 7	−15	4	5	− 5	11	10	15

Other types of extramural support of research have been excluded. Considerable thought has been given to the wisdom of gathering concise information from purely local foundations. The diversity of such organizations and the lack of established granting policies with regard to type of research supported or the probable duration of interest in any research field

* The views and opinions expressed here are those of the authors and not necessarily those of the members of the Governing Board of the BSIE or the agencies they represent.

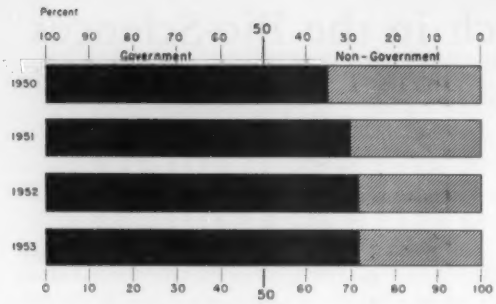

Fig. 1. Percentages of funds for research in the biosciences from government and nongovernment sources.

have reasoned against the inclusion of these data. Most local foundations appear to be mechanisms for family or individual giving with primary interest in community services and welfare. Additional local support of research reaches universities in the form of special contributions or bequests, and no effective procedure for obtaining current information on funds of this character can be established.

In this report, the year 1950 has been selected as a base for comparison, because the published figures for that year are the most complete, whereas those for 1951 represented only a part of the year. Although the 1951 figures have since been revised to reflect the total year, it is believed that the changes in 1952 and 1953 are better illustrated by a comparison with 1950. In the instances, however, where reference is made to 1951 amounts, the figures used are the revised or complete ones.

Table 1 carries the number of grants and amounts awarded in 1950, 1952, and 1953. It again discloses that increased funds from government sources have not diminished contributions from nongovernment agencies, despite the redirected programs of some private foundations.

Tables 2 and 3 illustrate, respectively, the percent-

TABLE 4. Number of states receiving grants.*

Fiscal year	Total states supported	Source of support		
		Government	Nongovernment	Both
1952	49	47	45	43
1953	48	48	42	42

* District of Columbia regarded as a state.

TABLE 5. State distribution of amounts from all sources.

Thousands of dollars	1950		1952		1953	
	State	Percentage	State	Percentage	State	Percentage
10,000–11,000					New York	20
7,500–10,000			New York	20		
5,000– 7,500	New York	19	Massachusetts	14	Massachusetts	13
2,500– 5,000	Massachusetts	10	California	8	California	9
	Illinois	9	Pennsylvania	7	Pennsylvania	7
	California	8	Illinois	7	Illinois	6
1,000– 2,500	Pennsylvania	7	Ohio	5	Ohio	4
	District of Columbia	5	Maryland	3	Michigan	3
	Maryland	4	Michigan	3	Maryland	3
	Ohio	4	Connecticut	3	Connecticut	3
			Minnesota	2	Minnesota	3
					North Carolina	2
					Missouri	2
					District of Columbia	2
750– 1,000	Michigan	3	District of Columbia	2	Louisiana	2
	Minnesota	3	Missouri	2	Texas	*
	Connecticut	2	North Carolina	2	Indiana	*
	Missouri	2			Utah	*
					Wisconsin	*
500– 750	North Carolina	2	Washington	2	Washington	*
	Louisiana	2	Texas	2	Kansas	*
	Tennessee	2	Louisiana	*	Tennessee	*
			Utah	*	Virginia	*
			Indiana	*	Colorado	*
			Wisconsin	*		
			Virginia	*		
			Tennessee	*		

* Less than 2 percent.

TABLE 5.—(*Continued*)

Thousands of dollars	1950 State	1950 Percentage	1952 State	1952 Percentage	1953 State	1953 Percentage
250– 500	Wisconsin	*	Colorado	*	Georgia	*
	Texas	*	Kansas	*	Florida	*
	Utah	*	Georgia	*	Maine	*
	Washington	*	Iowa	*	Iowa	*
	Colorado	*	Alabama	*	New Jersey	*
	Kansas	*	Maine	*	Oregon	*
	Virginia	*	New Jersey	*	Alabama	*
			Oregon	*		
100– 250	Indiana	*	Oklahoma	*	Oklahoma	*
	Georgia	*	Florida	*	Kentucky	*
	Maine	*	Kentucky	*	Rhode Island	*
	Iowa	*	New Mexico	*	South Carolina	*
	New Jersey	*	Nebraska	*	Nebraska	*
	Florida	*	Rhode Island	*		
	Oregon	*				
	Alabama	*				
	Oklahoma	*				
50– 100	New Mexico	*	Arkansas	*	Delaware	*
	Kentucky	*	South Carolina	*	Arkansas	*
	Vermont	*	Vermont	*	Vermont	*
	Nebraska	*	Montana	*	New Mexico	*
25– 50	Rhode Island	*	North Dakota	*	Montana	*
	Montana	*	Mississippi	*	New Hampshire	*
	South Carolina	*	South Dakota	*	South Dakota	*
	Arkansas	*			Mississippi	*
					Idaho	*
10– 25	South Dakota	*	Delaware	*	North Dakota	*
	Mississippi	*	Idaho	*	Arizona	*
	Arizona	*	West Virginia	*	West Virginia	*
	West Virginia	*	Arizona	*		
	North Dakota	*	New Hampshire	*		
	Wyoming	*				
Less than 10	Idaho	*	Wyoming	*	Wyoming	*
	New Hampshire	*	Nevada	*		
No funds	Delaware				Nevada	
	Nevada					

* Less than 2 percent.

age increases in amounts over 1950 and the annual percentage increases during a 4-year period. When these increases are calculated for the longer period, the proportional increase from government sources greatly exceeds that from nongovernment sources. When the annual changes are examined, however, it is evident that the percentage increases from nongovernment sources are growing and are approaching, in percentage, the government figure, although the disparity in amount still is great. It is of interest that the greatest percentage increase in government funds occurred in 1951, whereas the highest nongovernment percentage rise was in 1953. Nevertheless, government sources are still accounting for 72 percent of this type of research support (Fig. 1).

The awards within the United States amounted to $16,710,135 (97 percent of the total) in 1952 and to $53,972,797 (96 percent) in 1953. Nongovernment agencies contributed more generously than government ones in both years to research in foreign countries.

Within the United States (for purposes of this report, the District of Columbia is considered a state), the number of states supported and the distribution of funds among the states are essentially the same as in 1950. Tables 4 and 5 illustrate the distribution of awards among the states. In all 3 years, five states—New York, Massachusetts, Illinois, California, and Pennsylvania—account for more than 50 percent of the total funds. When the awards to the District of Columbia, Maryland, Ohio, Michigan, Minnesota, Connecticut, Missouri, and North Carolina are added, more than 75 percent of the total funds are accounted for.

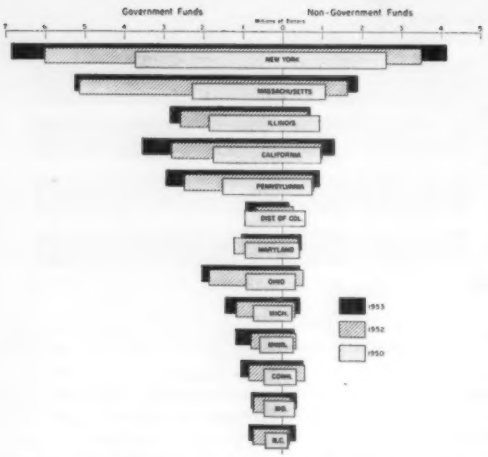

Fig. 2. Distribution of funds to 13 states receiving annually more than 75 percent of the total.

Figure 2 presents the amounts received by these 13 states in each of the 3 years. It indicates that the increase in nongovernment funds in the last 2 years has been largely absorbed by New York, Massachusetts, and California, whereas the government increase is more widely spread.

The distribution of grants by size (Table 6) has changed little since 1950. The trend toward fewer grants below $5000 and more between $5000 and $10,000, which was well established by 1950, has continued and is emphasized still further in 1952 and 1953. There is little change in the percentage distribution of grants of other sizes, and the percentage of all grants in amounts of $20,000 and over remains approximately 11 percent.

An interesting facet of this study is revealed in the number of investigators associated with research supported by extramural funds. The material available in the Exchange does not yet warrant an exhaustive analysis, which will be possible after a longer interval, but certain figures are well worth presenting at this time.

TABLE 6. Percentage distribution of grants by size.

Thousands of dollars	All grants		Government grants		Nongovernment grants	
	1952	1953	1952	1953	1952	1953
0– 4.9	30	28	25	24	42	36
5– 9.9	35	37	36	38	33	36
10–19.9	24	24	27	27	15	16
20–29.9	6	6	7	6	4	6
30–39.9	2	2	2	3	2	2
40–49.9	1	1	1	1	1	1
50–above	2	2	2	1	3	3

From 1946 through 1953, the names of 12,569 professional persons have been registered with the Exchange. This figure represents *different individuals* and is not a summation of the number of investigators registered in each successive year. Of these individuals, 5398 were designated principal investigators and the remaining 7171 were associated with the research in other professional capacities.

Turning to the number of investigators supported each year, the annual increase from the base year 1950 is illustrated in Table 7, which shows in 1953

TABLE 7. Distribution of awards among investigators.

All investigators	1950		1951		1952		1953	
	No.	%	No.	%	No.	%	No.	%
Total	3053	100	5496	100	6629	100	7693	100
Registered first time	1431	47	3136	57	3144	47	2791	36
Registered in 1 year only	390	13	1216	22	1332	20		

Principal investigators	1950		1951		1952		1953	
	No.	%	No.	%	No.	%	No.	%
Total	2271	100	2555	100	3003	100	3310	100
Registered first time	897	39	758	30	896	30	641	19
Registered in 1 year only	220	10	195	8	310	10		

Other professional personnel	1950		1951		1952		1953	
	No.	%	No.	%	No.	%	No.	%
Total	782	100	2941	100	3626	100	4383	100
Registered first time	534	68	2378	81	2248	62	2150	49
Registered in 1 year only	170	22	1021	35	1022	28		

an increase of 4640 investigators over 1950. The increase in principal investigators during this same period was more than 1000.

The number of investigators whose names appear for the first time in each of these 4 years clearly emphasizes the wide distribution of awards among scientists. The names of from 600 to 800 new principal investigators appear each year along with an even greater number of associated investigators in every year except 1950.

Our earlier findings established the continuity of support of projects; our present findings indicate the continuity of support of men: approximately 75 percent of all investigators and 90 percent of all principal investigators have received 2 or more years of support. The following brief tabulation shows the duration of support of the 897 principal investigators who worked under extramural funds for the first time in 1950.

	No. of principal investigators	*Percentage*
Total	897	100
1 year	220	25
2 years	218	24
3 years	196	22
4 years	263	29

One wonders what has happened to 1522 investigators (1196 principal, 326 other) who were supported at some time up to and including 1950 but whose names have not been associated with extramurally supported research in 1951, 1952, or 1953. Death and retirement for age account for a share, but how many have been otherwise diverted from research or have not measured up to the standards of granting agencies is in the realm of speculation. Referring again to Table 7, 13 to 22 percent of all investigators and 8 to 10 percent of the principal investigators appear to receive support for 1 year only.

The subject analysis that follows is based entirely on the multiple subject category method of indexing. After long consideration and continued trial, the division of total funds into single subject categories was discarded in the belief that the number of arbitrary decisions involved negates the value of results that could be achieved with equal accuracy by far less refined techniques than the scrutiny of individual projects. The distribution of funds among disciplines was likewise rejected, because there are no criterions for determining boundaries of disciplines and no sound method of distinguishing between them.

To understand the multiple subject category method of indexing, it must be recognized that every major category or topic of the first order is simply the title of an individual index, which is independent of all other major categories and is complete for the whole body of the material under consideration. In other words, each of the approximately 100 major categories of the index represents a different aspect and

TABLE 8. Amounts awarded major multiple subject categories.

Subject category	1950		1952		1953	
	No. of grants	Amounts	No. of grants	Amounts	No. of grants	Amounts
Cancer	631	6,914,144	770	8,309,327	936	10,397,088
Government	332	3,377,875	413	4,369,981	537	5,800,075
Nongovernment	299	3,536,269	357	3,939,346	399	4,597,013
Infectious diseases	412	5,672,626	512	8,137,035	574	8,540,463
Government	297	3,373,845	386	4,730,744	438	5,654,239
Nongovernment	115	2,298,781	126	3,406,291	136	2,886,224
Cardiovascular system	532	5,164,825	648	6,742,892	802	8,160,359
Government	375	3,929,867	482	5,614,281	598	6,670,751
Nongovernment	157	1,234,958	166	1,128,611	204	1,489,608
Metabolism and metabolic diseases	426	3,818,337	748	7,631,177	982	10,774,049
Government	281	2,569,971	553	5,956,636	739	8,777,383
Nongovernment	145	1,248,366	195	1,674,541	243	1,996,666
Nervous system	273	3,571,999	420	6,549,718	460	6,314,655
Government	151	1,447,962	293	3,128,009	334	3,445,016
Nongovernment	122	2,124,037	127	3,421,709	126	2,869,639
Endocrine system	400	3,434,342	694	7,019,425	698	7,763,255
Government	285	2,537,556	507	5,494,575	505	5,990,631
Nongovernment	115	896,786	187	1,524,850	193	1,772,624
Psychological sciences	227	3,113,713	397	6,453,353	395	6,679,359
Government	194	2,744,604	330	5,350,343	333	5,237,854
Nongovernment	33	369,109	67	1,103,010	62	1,441,505
Musculoskeletal system	208	2,985,312	268	5,545,322	259	4,895,456
Government	89	814,015	147	2,153,426	147	2,044,042
Nongovernment	119	2,171,297	121	3,391,896	112	2,851,414
Urogenital system	259	2,110,283	432	3,827,622	453	4,052,297
Government	171	1,511,678	300	3,017,980	308	3,026,722
Nongovernment	88	598,605	132	809,642	145	1,025,575

TABLE 8.—(*Continued*)

Subject category	1950		1952		1953	
	No. of grants	Amounts	No. of grants	Amounts	No. of grants	Amounts
Deficiency diseases and nutrition	225	1,886,074	348	3,329,065	400	3,974,572
Government	126	1,266,228	216	2,412,884	269	3,008,094
Nongovernment	99	619,846	132	916,181	131	966,478
Problems of children	199	1,875,804	290	2,847,621	295	2,939,987
Government	134	1,357,930	209	2,087,427	195	2,023,110
Nongovernment	65	517,874	81	760,194	100	916,877
Digestive system	236	1,752,511	306	3,163,405	358	3,556,674
Government	186	1,515,606	250	2,819,772	295	3,117,021
Nongovernment	50	236,905	56	343,633	63	439,653
Blood	182	1,679,794	383	4,756,605	444	5,429,282
Government	118	1,282,404	309	4,187,694	356	4,854,394
Nongovernment	64	397,390	74	568,911	88	574,888
Injury and shock	120	1,471,426	257	4,273,339	297	5,059,927
Government	98	1,332,983	238	4,127,977	278	4,933,023
Nongovernment	22	138,443	19	145,362	19	126,904
Respiratory system	107	1,022,819	215	2,521,973	256	3,101,276
Government	86	871,522	175	2,164,717	199	2,535,741
Nongovernment	21	151,297	40	357,256	57	565,535
Ageing	76	981,640	104	1,129,545	127	1,403,125
Government	52	753,494	83	928,979	102	1,113,315
Nongovernment	24	228,146	21	200,566	25	289,810
Emotional and psychiatric states	78	966,283	125	1,684,760	111	1,615,727
Government	70	877,933	113	1,473,955	102	1,388,609
Nongovernment	8	88,350	12	210,805	9	227,118
Integumentary system	57	610,786	81	965,798	100	1,196,596
Government	45	554,311	69	851,873	82	978,154
Nongovernment	12	56,475	12	113,925	18	218,442
Public health	35	593,570	55	799,644	53	761,395
Government	19	404,338	36	613,011	36	539,436
Nongovernment	16	189,232	19	186,633	17	221,959
Ecology and environment	55	582,918	122	1,473,052	203	2,343,715
Government	44	524,013	107	1,378,058	191	2,223,882
Nongovernment	11	58,905	15	94,994	12	119,833
Sanitary engineering	54	559,097	68	706,707	81	1,000,896
Government	51	528,017	66	547,456	76	817,030
Nongovernment	3	31,080	2	159,251	5	183,866
Sensory organs	50	538,112	144	1,493,514	156	1,659,496
Government	45	487,468	123	1,401,947	124	1,488,390
Nongovernment	5	50,644	21	91,567	32	171,106
Venereal diseases	31	453,605	21	208,446	14	97,207
Government	29	441,405	19	204,346	13	95,407
Nongovernment	2	12,200	2	4,100	1	1,800
Stress	24	355,748	131	1,637,323	158	2,283,455
Government	16	282,929	114	1,444,380	136	2,050,782
Nongovernment	8	72,819	17	192,943	22	232,673
Allergy and anaphylaxis	46	336,661	80	818,369	81	819,964
Government	37	249,021	68	746,814	69	727,728
Nongovernment	9	87,640	12	71,555	12	92,236
Dental research	50	313,836	63	436,575	98	805,766
Government	43	283,736	55	400,821	89	760,688
Nongovernment	7	30,100	8	35,754	9	45,078
Anesthesia and analgesia	25	260,577	37	346,041	52	426,435
Government	21	245,027	33	321,805	46	378,362
Nongovernment	4	15,550	4	24,236	6	48,073
Occupational diseases	21	166,327	28	355,642	37	518,068
Government	18	137,827	24	281,655	31	412,944
Nongovernment	3	28,500	4	73,987	6	105,124
Intoxication and drug addiction	11	77,336	19	114,866	20	150,793
Government	6	47,081	10	78,832	9	98,254
Nongovernment	5	30,255	9	36,034	11	52,539

provides a survey of the whole body of material from a particular point of view. It should be clear now that the funds awarded to the major categories cannot be added, since the same problem is usually involved in several major categories. Within each major category, it is a relatively simple matter to assign a problem to a particular subcategory; consequently, a project falls only once within a major category and the funds awarded to any major category may be divided among its subcategories.

It is obvious that in a report of this type all the major categories cannot be considered. The number of these topics is continually growing in accordance with new interests of investigators and of granting agencies. Twenty-nine of the major categories have been selected for presentation. These are, with one exception, those used in the earlier report (*1*) and are those of interest to the greatest number of granting agencies. The exception is that the category "Psychological sciences" has replaced the category "Social sciences."

The increases in total funds in 1952 and 1953 over those awarded in 1950 have been reflected in 28 of the 29 categories under consideration. The "Venereal diseases" category is the only one that has had a pronounced decrease in support and by 1953 received only 21 percent of the amount it had in 1950. Table 8 shows the funds awarded each of these major categories.

Eight of the 10 most liberally supported fields in 1950 are among the 10 receiving the highest support in both 1952 and 1953. The two fields that dropped out of the top bracket are the "Urogenital system" and "Deficiency diseases and nutrition," both of which, while receiving considerable increases in 1952 and 1953, were overshadowed by the added support awarded for studies of "Blood" and of "Injury and shock."

Although research in no one of the categories "Pub-

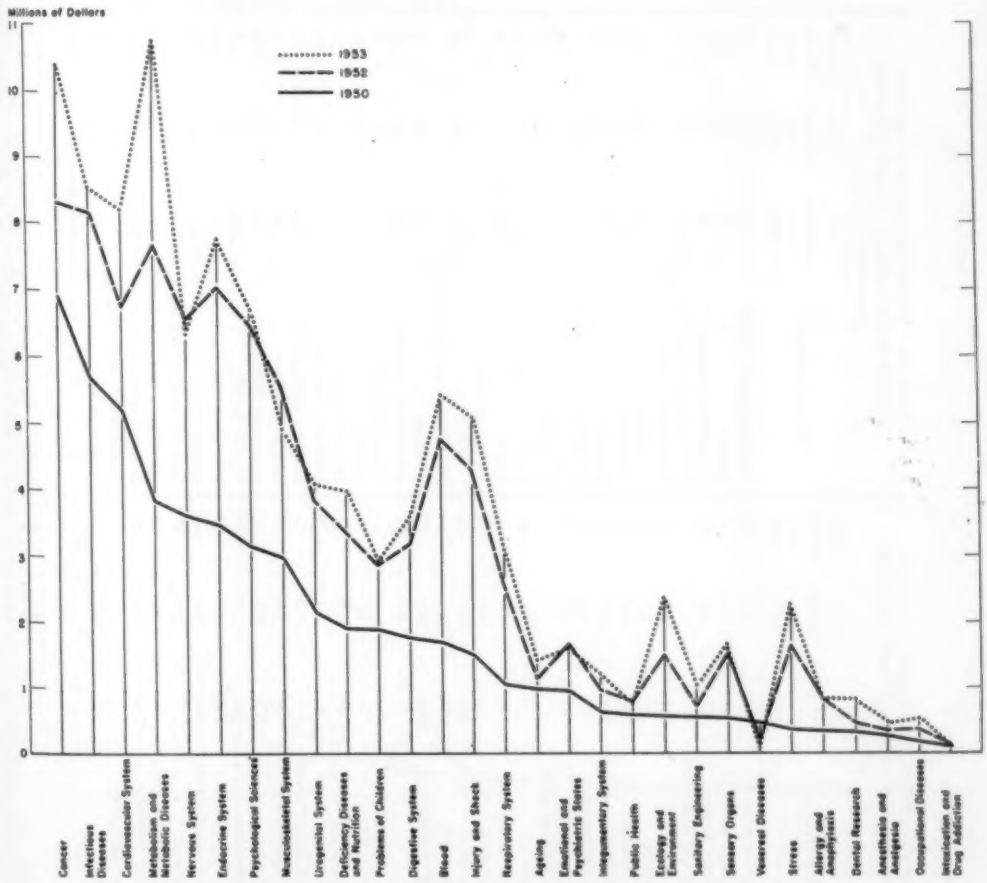

Fig. 3. Amounts awarded multiple subject categories from all sources.

TABLE 9. Percentage changes in amounts awarded major multiple subject categories, all sources.

Subject category	1952 change over 1950	1953 change over 1950	1953 change over 1952
Cancer	20	50	25
Infectious diseases	43	51	5
Cardiovascular system	31	58	21
Metabolism and metabolic diseases	100	182	41
Nervous system	83	77	− 4
Endocrine system	104	126	11
Psychological sciences	107	115	4
Musculoskeletal system	86	64	− 12
Urogenital system	81	92	6
Deficiency diseases and nutrition	77	111	19
Problems of children	52	57	3
Digestive system	81	103	12
Blood	183	223	14
Injury and shock	190	244	18
Respiratory system	147	203	23
Ageing	15	43	24
Emotional and psychiatric states	74	67	− 4
Integumentary system	58	96	24
Public health	35	28	− 5
Ecology and environment	153	302	59
Sanitary engineering	26	79	42
Sensory organs	178	208	11
Venereal diseases	− 54	− 79	− 53
Stress	360	542	40
Allergy and anaphylaxis	143	144	—
Dental research	39	157	85
Anesthesia and analgesia	33	64	23
Occupational diseases	114	212	46
Intoxication and drug addiction	49	95	31

TABLE 10. Percentage changes in amounts awarded major multiple subject categories, government sources.

Subject category	1952 change over 1950	1953 change over 1950	1953 change over 1952
Cardiovascular system	43	70	19
Cancer	29	72	33
Infectious diseases	40	68	20
Psychological sciences	95	91	− 2
Metabolism and metabolic diseases	132	242	47
Endocrine system	117	136	9
Digestive system	86	106	11
Urogenital system	100	100	—
Nervous system	116	138	10
Problems of children	54	49	− 3
Injury and shock	210	270	20
Blood	227	279	16
Deficiency diseases and nutrition	91	138	25
Emotional and psychiatric states	68	58	− 6
Respiratory system	148	191	17
Musculoskeletal system	165	151	− 5
Ageing	23	48	20
Integumentary system	54	77	15
Sanitary engineering	4	55	49
Ecology and environment	163	324	61
Sensory organs	188	205	6
Venereal diseases	− 54	− 78	− 53
Public health	52	33	− 12
Dental research	41	168	90
Stress	411	625	42
Allergy and anaphylaxis	200	192	− 3
Anesthesia and analgesia	31	54	18
Occupational diseases	104	200	47
Intoxication and drug addiction	67	109	25

TABLE 11. Percentage changes in amounts awarded major multiple subject categories, nongovernment sources.

Subject category	1952 change over 1950	1953 change over 1950	1953 over change 1952
Cancer	11	30	17
Infectious diseases	48	26	− 15
Musculoskeletal system	56	31	− 16
Nervous system	61	35	− 16
Metabolism and metabolic diseases	34	60	19
Cardiovascular system	− 9	21	32
Endocrine system	70	98	16
Deficiency diseases and nutrition	48	56	6
Urogenital system	35	71	27
Problems of children	47	77	21
Blood	43	45	1
Psychological sciences	199	291	31
Digestive system	45	86	28
Ageing	− 12	27	45
Public health	− 1	17	19
Respiratory system	136	274	58
Injury and shock	5	− 8	− 13
Emotional and psychiatric states	139	157	8
Allergy and anaphylaxis	− 18	5	29
Stress	165	220	21
Ecology and environment	61	103	26
Integumentary system	102	287	92
Sensory organs	81	238	87
Sanitary engineering	412	492	16
Intoxication and drug addiction	19	74	46
Dental research	19	50	26
Occupational diseases	160	269	42
Anesthesia and analgesia	56	209	98
Venereal diseases	− 66	− 85	− 56

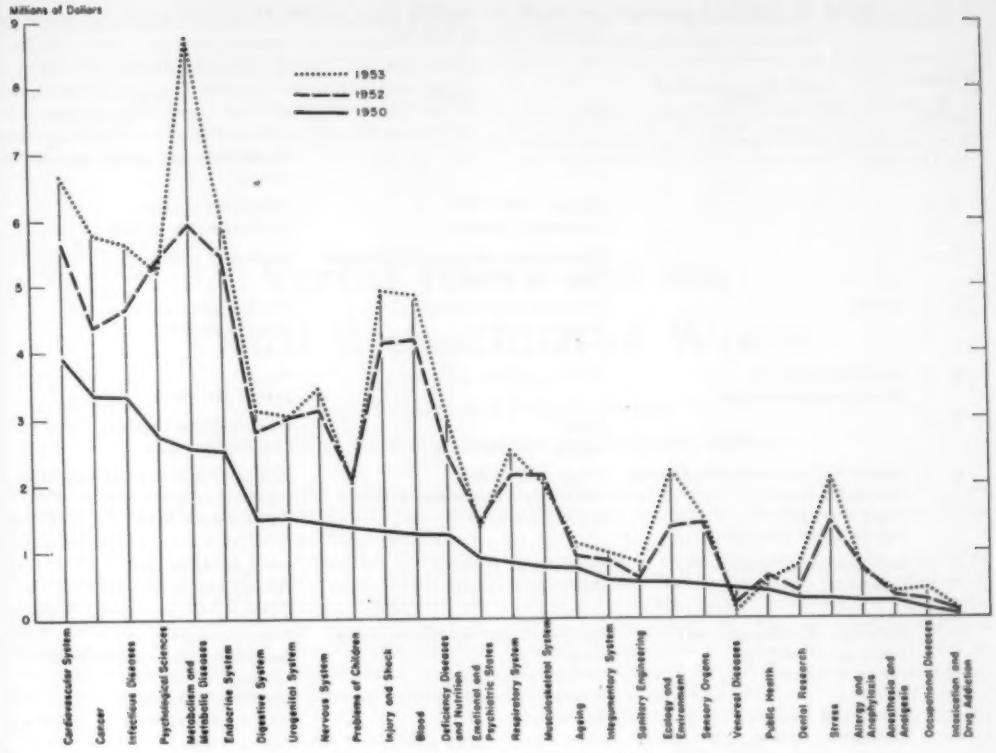

Fig. 4. Amounts awarded multiple subject categories from government sources.

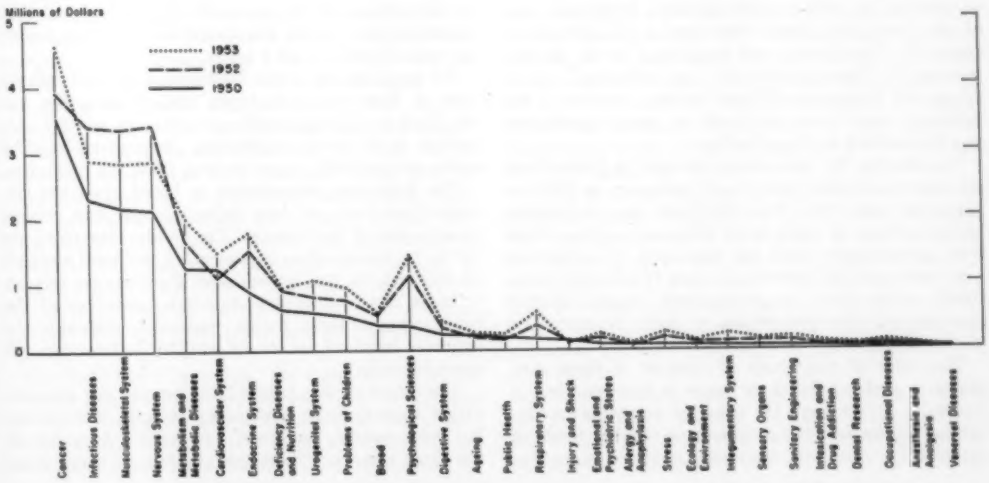

Fig. 5. Amounts awarded multiple subject categories from nongovernment sources.

TABLE 12. Order of magnitude of support of selected major multiple subject categories, amounts from all sources.

Millions of dollars	1950	1952	1953
10–11			Metabolism and metabolic diseases Cancer
8– 9		Cancer Infectious diseases	Infectious diseases Cardiovascular system
7– 8		Metabolism and metabolic diseases Endocrine system	Endocrine system
6– 7	Cancer	Cardiovascular system Nervous system Psychological sciences	Psychological sciences Nervous system
5– 6	Infectious diseases Cardiovascular system	Musculoskeletal system	Blood Injury and shock
4– 5		Blood Injury and shock	Musculoskeletal system Urogenital system
3– 4	Metabolism and metabolic diseases Nervous system Endocrine system Psychological sciences	Urogenital system Deficiency diseases and nutrition Digestive system	Deficiency diseases and nutrition Digestive system Respiratory system
2– 3	Musculoskeletal system Urogenital system	Problems of children Respiratory system	Problems of children Ecology and environment Stress
1– 2	Deficiency diseases and nutrition Problems of children Digestive system Blood Injury and shock Respiratory system	Emotional and psychiatric states Stress Sensory organs Ecology and environment Ageing	Sensory organs Emotional and psychiatric states Ageing Integumentary system Sanitary engineering

lic health," "Allergy and anaphylaxis," "Dental research," "Anesthesia and analgesia," "Occupational diseases," and "Intoxication and drug addiction" has been awarded a million dollars or more in any of the 3 years, the money available in 1953 is at least twice as great as in 1950 in three of these categories, and of the remaining three, there was a 64 percent increase in "Anesthesia and analgesia," a 95 percent increase in "Intoxication and drug addiction," and a 28 percent increase in "Public health." In view of the relatively small sums involved, no great significance can be attached to these findings.

Considering the percentage changes in funds from all sources awarded each major category in 1953 as compared with 1950 (Table 9), there was an increase of 100 percent or more in 14 categories. If the funds from government alone are examined, 17 categories were increased 100 percent or more (Table 10), while funds solely from nongovernment sources showed increases of this proportion in only 10 categories (Table 11).

The order of magnitude of support of these categories in each of the three years is demonstrated in Table 12. It portrays the growing emphasis on metabolic studies and the maintenance of high levels of support for research on cancer, research on cardiovascular, system and research on infectious diseases.

Figures 3, 4, and 5 illustrate the changes in order of magnitude in support of the selected major categories in 1952 and 1953 as contrasted with 1950. It is clear that government sources are largely responsible for the changes in emphasis of subject field and that nongovernment funds are distributed in more nearly the same fashion in all 3 years.

An examination of the distribution of funds within each of these major multiple subject categories has not disclosed changes sufficient either to merit a discussion or to justify publishing detailed tables. The tables are available, upon request, from the Exchange.

The foregoing presentation is based upon the circumscribed body of data defined in the first several paragraphs of this report. The funds, therefore, are not to be construed as representing the total support of research in the bio-sciences. Further, no reliable estimate can be offered as to what percentage of the total support these funds represent, although the amounts involved, 48 to 56 million dollars, are not inconsiderable.

The intent of this report is to present the material rather than to draw conclusions from it. The following brief resumé, therefore, sets forth only a few of the facts emerging from the analysis of these data:

the mounting funds available for research in the biosciences from both government and nongovernment sources; the growing number of investigators receiving research awards, especially the many new names that appear each year; and finally, the shift in the pattern of order of support of subject categories evidenced in government-supported research as contrasted with the relative stability of the pattern in nongovernment-supported research.

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1. S. L. Deignan and E. Miller, *Science* **115**, 321 (1952).
2. In this report the term *grant* is used to mean an amount of money approved for the support of a project for the period of 1 year and refers to both grants and contracts.

Verbal Habits and the Visual Recognition of Words

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There is considerable experimental evidence that the threshold of visual recognition for words varies with the familiarity of the stimuli. Significant correlations have been found between the recognition thresholds for words and the frequencies with which these words occur in written English (*1–4*). The question remains open, however, whether it is the frequency of past visual exposure to the stimuli *per se* or frequency of past usage of the words that is the essential variable. The following experiments are concerned with this problem.

Experiment I. Visual recognition thresholds were determined for 27 three-letter English words. The words were chosen so as to represent (i) different frequencies of usage as English words, and (ii) visual stimulus patterns of different frequencies of occurrence. Estimates of frequency of usage are provided by the Thorndike-Lorge word counts (*5*). These counts are based on large samples of written English but do not, of course, measure the actual frequency of usage in spoken English. For our purposes, they provide estimates of the frequencies with which we respond to different combinations of letters as *word units*.

A given three-letter combination may not only be a word in its own right but also form part of a variety of other words. Thus, the three-letter sequence *fin* not only is a meaningful word but also forms part of other words, such as *finger, define, finish*. Such three-letter sequences, regardless of whether or not they form meaningful English words, are designated as *trigrams*. The relative frequencies of trigrams in written English may be used to estimate the frequencies with which they function as visual stimuli in reading. Such a trigram count has been published by Pratt (*6*).

For three-letter sequences, the frequency of usage as words and the frequency of occurrence as trigrams are, to a considerable degree, independent. For a sample of 356 words that appear both in Pratt's trigram count and in the Thorndike-Lorge word counts, the correlation between the two measures is .30. For our experimental sample of 27 words, the correlation is .20.

The stimulus words and their frequency values as words and as trigrams appear in Table 1. The word counts refer to frequencies of occurrence in samples of 4½ million words; the trigram count is based on relative frequencies in a sample of 20,000 words. Since the ranges of frequencies are wide, it is appropriate to scale them logarithmically (*7*). When the two frequency scales are divided into high, medium, and low values, the stimulus words sample all possible combinations of values of the two variables.

The words were presented for recognition by means of a slide projector. The order of presentation was random. The speed of exposure, controlled by a photographic shutter, was held constant at 0.01 sec. Variations in the brightness of the flash were used to determine the threshold of recognition. Starting at a fixed low intensity, the flash intensity was increased in 1-v steps on each successive trial. Fourteen such exposures were given for each word; this was a sufficient number of exposures to insure recognition by virtually all subjects. The number of exposures required for recognition was used as the measure of the threshold. Twenty-one students at the University of California served as subjects.

To make the recognition scores of different subjects comparable, all threshold measures were converted into standard scores. Scatter plots of the thresholds as a function of the two frequency variables are presented in Fig. 1. The higher the frequency of word usage, the lower the recognition threshold tends to be. The product-moment correlation is $-.39$, which is significantly different from zero at the 5-percent level of confidence.

As Fig. 1 shows, there is no relationship between recognition thresholds and the trigram frequency of the words. The product-moment correlation is .09, which is not significantly different from zero, and in

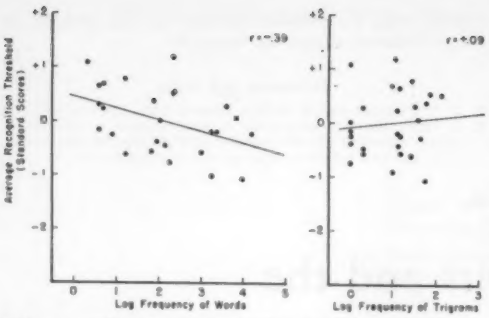

Fig. 1. Scatter diagrams showing recognition thresholds as a function of log frequency of word usage and log frequency of trigrams.

the wrong direction at that. The picture does not change when partial correlations are computed. The correlation between frequency of word usage and recognition thresholds, holding trigram frequency constant, is raised from $-.39$ to $-.43$, a value significant at the 3-percent level of confidence. When the frequency of word usage is held constant, the correlation between trigram frequency and recognition thresholds is .19, which is not significantly different from zero.

Our results point to the importance of *verbal habits* as determiners of the speed of recognition of letter sequences. When a word is presented rapidly and at low illumination, only a part of the stimulus pattern is likely to be discriminated. On the basis of such incomplete cues, the subject may then attempt to reconstruct the stimulus word. The stimulus fragments that have been discriminated may form part of several different words. Which of these words will be elicited by a given stimulus fragment depends, we assume, on the relative frequencies with which the alternative verbal responses have been given in the past. If the stimulus is a high-frequency word, a correct response in the presence of incomplete cues is highly probable.

This analysis is supported by an examination of the subjects' errors prior to correct recognition. Figure 2 compares the frequencies of usage of incorrect response words (δ) with those of the stimulus words. The log frequency of each incorrect response word was expressed as a deviation from the log frequency of the stimulus word. The stimulus words were then divided into three groups, namely, words of relatively high, medium, and low frequency of usage. For each of these groups, the average discrepancy between the log frequency of the incorrect response words and the log frequency of the stimulus words is plotted in Fig. 2. In the case of low-frequency stimulus words, the subjects respond with words that are more frequent than the stimuli. The same relationship exists, but to a lesser degree, for the stimulus words of medium frequency. Incorrect responses to high-frequency words are actually lower in frequency of usage than the stimulus words. The general picture presented by Fig. 2 is the familiar one of regression toward the mean. We are, however, not dealing with a mere statistical artifact. As Fig. 2 shows, the positive discrepancy between response words and low-frequency stimulus words is considerably greater than the negative discrepancy between response words and high-frequency stimulus words. This fact, in conjunction with the positive discrepancy for medium-frequency stimulus words, supports the view that subjects respond with relatively frequent words in the presence of incomplete stimulus cues.

The results of this experiment agree with the hypothesis that frequency of response to stimulus units, rather than sheer frequency of visual exposure, is a significant determinant of speed of recognition. Since all the stimuli were words, the situation was maximally favorable to the determination of recognition responses by verbal habits. The effects of relative exposure frequency may, therefore, have been masked by the verbal response habits. It seemed advisable to repeat the experiment, using three-letter nonsense syllables that varied in frequency of occurrence as trigrams in written English. Such a series of stimuli should provide maximum opportunity for the effects of exposure frequency to manifest themselves independently of verbal habits.

TABLE 1. Stimuli used in the experiments.

Experiment I			Experiment II	
Word	Log frequency of word usage*	Log frequency of trigram	Syllable	Log frequency of trigram
can	3.83	1.60	nat	1.60
end	3.22	1.64	ist	1.61
out	3.98	1.73	ain	1.78
arm	3.37	1.11	alt	1.20
him	4.18	1.18	hir	1.23
set	3.25	1.00[5]	dem	1.00
bed	3.00	0.30	dah	0.30
job	3.00	.30	jac	.30
sir	3.59	.30	gir	.30
ate	2.34	2.14	ati	2.11
ore	1.88	1.80	ove	1.81
wit	2.37	1.88	rom	1.81
ash	2.13	1.15	ang	1.23
kin	1.82	1.18	hil	1.20
ton	2.35	1.08	tif	1.08
jam	2.03	0.0	kam	0.0
shy	1.95	.0	smo	.0
rug	2.24	.0	rup	.0
ire	0.60	1.52	ile	1.52
fin	1.18	1.45	fer	1.45
pub	1.20	1.42	pos	1.42
elf	0.70	1.11	emb	1.11
lop	.70	1.00	rov	1.00
cam	.60	1.18	ced	1.18
cob	.90	0.0	eib	0.0
ilk	.30	.0	isk	.0
pun	.60	.0	tus	.0

* Average of Lorge Magazine and Semantic counts in Thorndike and Lorge (*5*).

Experiment II. Recognition thresholds were determined for 27 three-letter nonsense syllables. The stimuli and their frequency values as trigrams in written English appear in Table 1. The distribution of trigram frequencies used in Experiment I was duplicated as closely as possible. The experimental procedure was in all respects the same as in Experiment I. Twenty-three students served as subjects.

The results again fail to show any relationship between recognition thresholds and trigram frequency. The correlation coefficient is .10, which is almost identical with the coefficient of .09 obtained in Experiment I (*9*). The subjects' errors prior to correct recognition also fail to show any systematic tendency to respond in terms of relatively frequent letter sequences. Figure 3 compares the frequencies of incorrect three-letter responses with those of the stimulus trigram. The frequencies of the response trigrams are in general low. Incorrect responses to high-frequency trigrams have considerably lower frequency values than the stimuli. The same relationship holds, but to a lesser degree, for stimulus trigrams of medium frequency. For low-frequency trigrams, there is virtually no difference in frequency between stimuli and incorrect responses. Comparison of Figs. 2 and 3 brings out clearly the bias toward relatively frequent responses in the case of words but not in the case of meaningless three-letter sequences.

The frequency values of the trigrams refer primarily to their occurrence as parts of longer words. Recognition was, therefore, tested under conditions different from those under which the three-letter sequences are ordinarily encountered. There is some evidence that familiar letter groupings are recognized faster than unfamiliar ones when presented as parts of long sequences of letters (*10*). In such cases, familiar word responses may generalize to nonsense sequences that approximate to various degrees the structure of English words. Our stimuli, on the other hand, were designed to test the effects of the sheer frequency of past exposure independently of associative context.

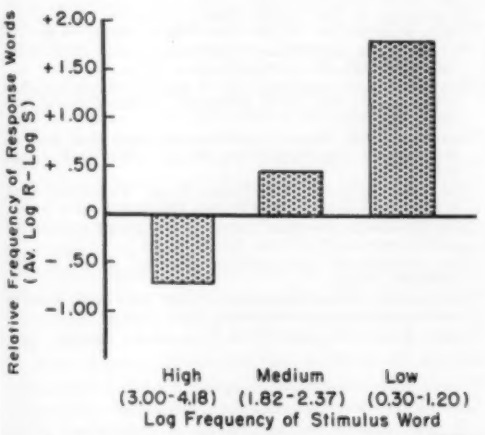

Fig. 2. Relative frequency of incorrect word responses given to stimulus words of high, medium, and low frequency.

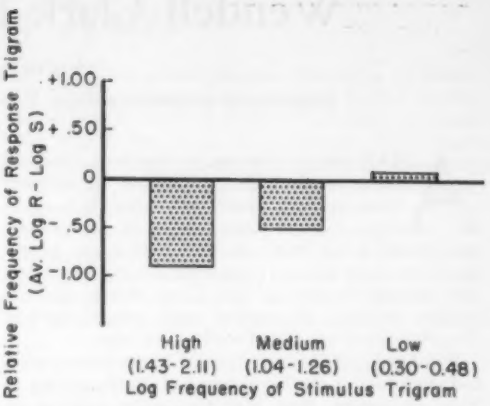

Fig. 3. Relative frequency of incorrect three-letter responses given to stimulus trigrams of high, medium, and low frequency.

We conclude that the speed of recognition for letter sequences varies significantly with the strength of the verbal habits associated with such stimuli. There are no demonstrable effects of sheer frequency of exposure.

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3. L. Postman and B. M. Schneider, *Psychol. Rev.* **58**, 271 (1951).
4. R. L. Solomon and D. H. Howes, *Psychol. Rev.* **58**, 256 (1951).
5. E. Thorndike and I. Lorge, *The Teachers' Word Book of 30,000 Words* (Bureau of Publications, Teachers' College, Columbia University, New York, 1944).
6. F. Pratt, *Secret and Urgent* (Bobbs-Merrill, Indianapolis, 1939), p. 264.
7. An inverse linear relationship between log frequency of usage and recognition thresholds was reported by Howes and Solomon (*1*).
8. Only incorrect word responses are considered here. There were, of course, other errors, including three-letter nonsense sequences.
9. The scatter plot is not presented here since it is substantially like that shown in Fig. 1.
10. G. A. Miller, J. S. Bruner, and L. Postman, *J. Gen. Psychol.* **50**, 129 (1954).

Wendell Clark Bennett: 1905-1953

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A MAN died in the sea at Martha's Vineyard on Sept. 6, 1953. He was not an ordinary man, for the heart that failed him as he swam toward shore was, as we say in common words, a big heart. In all his 48 years, people loved him more than it is usual for a man to be loved. The children laughed at his funny stories and old Indians, brown as the Andean sand, were warmed by the gentle kindness they found in his eyes.

Wendell Clark Bennett, director of graduate studies and chairman of the Department of Anthropology at Yale University, first saw his native country in Marion, Ind., on Aug. 17, 1905. His fellow townspeople did not guess that before his career had hardly started he would be made a Caballero of the Orden del Condor de los Andes by the Bolivian Government. Even the sophisticated villagers of Oak Park in Illinois where he spent much of his youth could not foresee his unusual life. They accepted his education at the University of Chicago as right and proper and probably were not even surprised to find so successful a student obtaining his Ph.D. degree there in 1930.

The unusual thing appeared with the pattern of intensive field work which, except for an early year in Hawaii and another in Mexico, was concentrated in the great mountain area of South America. He did this work while on the staff of the American Museum from 1931 to 1938 and at Yale since 1940. During the intervening 2 years, he taught as associate professor of anthropology at the University of Wisconsin. Hardly a score of months ever passed without his conducting field research, but if this pointed to an extraordinary devotion to his subject, that achievement fades in the light of his having issued his research results with unequaled regularity and completeness. His complete bibliography includes about 100 titles. In a short life, few men have published so much and so well. It was in recognition of this that as almost the last of his many honors he served as president of the American Anthropological Association.

In 1935, he married a beautiful girl, Hope Ranslow, and she and two daughters survive the tragedy of a summer Sunday afternoon. For them, as for many others, there is the safe memory of his goodness, his helpfulness to student and friend and stranger. His intimates will never forget his songs of the Andes sung as no ordinary man sings.

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News and Notes

American Association of Physical Anthropologists

The 23rd annual meeting of the American Association of Physical Anthropologists was held at the Fels Research Institute, Yellow Springs, Ohio, Mar. 26–28. Attendance, number and quality of the papers presented, and the lively character of the discussions testified to the vitality and scope of contemporary physical anthropology.

Fifteen of the 41 papers dealt with the skeleton. Of these, three were concerned with the genetics of osseous formation and skeletal growth (Brietnbach, Garn, and Rife; Sawin; Selby), two with the assessment of skeletal maturation in children (Sontag; Silverman), two with the determination of age in skeletal material (Stewart; Brooks), and one with the sexing of the skeleton (Thieme). Others dealt with prenatal chondrification (O'Rahilly and Gardner) and the weight of the skeleton in the adult (Trotter).

Human evolution, a core interest of physical anthropology, was represented directly by four papers (Washburn; Spuhler; Singer; Mednick) and indirectly by several others. The problem of the antiquity of anatomically modern man (Washburn) raised a lively discussion, while a report on the Saldanha skull, recently discovered at Hopefield, South Africa (Singer), was heard with great interest.

Human genetics was also well represented. In addition to the papers related to the skeleton, there were four papers in this area. They included a discussion of primate genetics as a path to the further understanding of human genetics (Tappen), a reevaluation of P.T.C. tasting data (Hoyme), the serology of the Chippewa (Matson), and evidence for linkage in hybrid populations of recent origin (Rife).

Applied physical anthropology, a field now in its second decade, was both heard and seen. Several papers, including accounts of work carried on under contract, illustrated contributions to basic knowledge (Evans and Lissner; Hertzberg, Emanuel and Saul; Dempster; R. W. Newman). A visit to the Wright Air Development Center, and the Wright-Patterson Air Force Base, provided insight into the practical problems in this field and how such problems are being solved.

Five papers illustrated the position of physical anthropology as a bridging discipline, bringing together the biological and social sciences. These dealt with the variety of human mating systems and their genetic implications (Aginsky), the question of physical selection of Mexican migrants (Lasker), migration, culture-contact, and disease in Polynesia (Marshall and Snow), the changing population profile in the state of Israel (Schulman), and social biology in a Cypriote village (Angel).

The meeting was attended by anatomists, geneticists, statisticians, and clinicians as well as by physical and social anthropologists. The range of interest was further shown in the individuals elected to office. W. Montague Cobb, of Howard University, an anatomist, was elected to the vice-presidency, while James N. Spuhler, of the University of Michigan (whose field of interest is human genetics) was elected to the executive committee. Paul Fejos, Research Director of the Wenner-Gren Foundation for Anthropological Research, speaking at the annual dinner of the Association, commented on the expansion of physical anthropology and on the need for "eyeglass" projects yielding both insight and perspectives into the study of man.

STANLEY M. GARN

The Fels Research Institute
Yellow Springs, Ohio

Differential Fertility and the Intelligence of New Generations

A negative association between intelligence, as measured by tests, and the number of children per family has been noted in all countries where tests have been widely applied. Since there is undoubtedly a substantial genetic component in intelligence, this negative association has formed the basis for fears that the average level of intelligence is declining. Several predictions have, in fact, been made of the probable rate of decline.

But the predictions have not been confirmed on the few occasions where it has been possible to test them directly. In the largest test, the 1947 survey of the intelligence of all 11-year-old children in Scotland showed no decline from the average obtained in a comparable survey 15 years earlier.

UNESCO convened a small working party in Paris on Feb. 1–4 to review the available evidence on differential fertility and intelligence and to prepare a report for the use of the World Population Conference which will meet in Rome next September. The group agreed that there had been no demonstrable decline in intelligence but that, possibly, the effects of differential fertility had acted to keep the average from improving. More precise statements are not possible because of a variety of probably influential factors that are not adequately understood. While standardized tests are believed to be appropriate for studying population changes in intelligence, part of the variation in test scores—perhaps 50 percent—is attributable to differences in culture and environment. Thus, educational and environmental differences might tend to mask a decline in genetic quality. Moreover, nearly all surveys have failed to take account of the childless members of the community. Differences in the numbers of childless persons might, therefore, compensate for the differential fertility of those who do have families. The working party recommended a number of investigations and research studies that

would secure a better factual background for future predictions concerning the intelligence of new generations.

The group concluded that at the present time there is no basis for pessimism. The effects of differential ability appear to be small at best, and, whatever the effect, it seems to be disappearing, for there are signs of increasing fertility among those members of the population who usually obtain relatively high scores on intelligence tests. In short, the group advised the World Population Conference that there need be no great concern over an impending decline in intelligence.

In addition to Alva Myrdall and Otto Klineberg of the UNESCO staff, the group included the following demographers, geneticists, and psychologists: Tage Kemp (Denmark), M. A. Girard and M. J. Sutter (France), Livio Livi (Italy), J. A. Böök (Sweden), J. A. Fraser Roberts and J. Maxwell (United Kingdom), and Dael Wolfle (United States). Professor Livi served as president and Mr. Sutter as rapporteur.

DAEL WOLFLE

American Association for the Advancement of Science
Washington 5, D.C.

Science News

A comprehensive 66-page report on **"The Fort Monmouth Security Investigations, August 1953–April 1954"** has been released by the Federation of American Scientists' Committee on Loyalty and Security. The report deals with both the Senate subcommittee investigation and the actions taken under the federal employee security program. It describes the Signal Corps Engineering Laboratories (SCEL) at Ft. Monmouth and attempts to assess the security threat and the disruptive effects of the investigations. The study was based on press reports, personal interviews, copies of charges and responding affidavits and various official documents. Rather complete information was available on all the suspendees and on some 90 percent of the approximately 50 believed to have been implicated. The report recommends that an official and even more detailed survey of the situation be made. An excerpt from the summary follows:

> No evidence of espionage at SCEL, in recent years or at present, was shown during the Subcommittee investigation. Most persons publicly linked with the investigation had little or no connection with the Laboratories, and only one of the 40-odd SCEL employees implicated by the Army was called before the Subcommittee in open hearings. None of these employees has refused to testify, on the grounds of possible self-incrimination or any other grounds: all have cooperated fully during the investigations, and have denied under oath the charges against them, or the conclusions inferred. The sensational headlines arising from the Subcommittee investigation have lowered morale.

The report states that the average employee involved is a 37-year-old Civil Service worker earning $7400 a year and supervising 14 persons. He has had 11 years service in the laboratories—more than two-thirds of his professional life. Twenty-nine of the employees were concerned with electronics—14 of these in radar work. At least 12 were among the 200 Monmouth laboratory civilians in Civil Service Grade GS-13 or higher.

The report urges the Presidential appointment of a scientific and administrative committee able to make a more complete study. It proposes that such a panel might explore any effects on research, the possibility of racial and religious prejudice, the background of the Army security personnel and the entire security program. Other FAS Committee suggestions on security procedures and principles follow: (*a*) the revocation of clearance would be preferred to suspension, provided that regular security hearing procedures, not now available to declassified employees, would apply; (*b*) time intervals should be shortened before final decisions; (*c*) any security board decision should be binding for at least two or three years unless "new clearly derogatory material" developed; (*d*) an adequate appeal mechanism should be provided.

A small, inexpensive, and **portable x-ray** unit that has potential uses in medicine and industry has been developed at Argonne National Laboratory of the Atomic Energy Commission and is being tested as a diagnostic tool. The active component of the instrument is a tiny particle of thulium which has been made radioactive. The thulium is mounted in a source holder and shield equipped with a shutter mechanism in order that x-ray photographs may be made. The shutter is operated by a standard photographic cable release.

The development, which was directed by Samuel Untermyer, may meet the long-time need for simple, cheap, and portable equipment. Although the entire unit weighs less than 10 lb, the radioactive thulium provides rays that are comparable in energy to a 100-kv x-ray machine. Further, the instrument does not require an electrical power supply. Exclusive of irradiation charges, the total cost of the first model was $40.

That the **general theory of relativity** is valid for purely gravitational phenomena, but breaks down as soon as electromagnetic effects come into play, was asserted in a paper presented during the meeting of the American Physical Society in Washington, Apr. 29–May 1, under the authorship of E. Findlay-Freundlich, University Observatory, St. Andrews, Scotland. Heretofore it has been rather generally accepted that the theory meets experiments not only for the movement of the perihelion of the planet Mercury—a purely gravitational effect—but also for the deflection of light by the sun and the so-called gravitational red-shifts.

For the light deflection, Findlay-Freundlich's investigation indicates that the observed value is about 30 percent higher than the one predicted theoretically. As for the red-shifts, he has shown that those

observed in the spectra of B and O stars are too large to be gravitational red-shifts such as are predicted by the theory of relativity. Suggesting that the shifts may be due to a loss of energy in the radiation field of the stars, he has proposed an equation that accounts for those observed in the spectra of the sun and of O, B, A, supergiant M, and W-R stars. In addition to the shift predicted by the equation, the data for the sun and for Sirius B (a white dwarf) seem to suggest the existence of a purely gravitational red-shift that is, however, only about one-fifth of the value predicted by the theory of relativity. The experimental data bearing on the Freundlich effect are discussed in detail in the March issue of the *Philosophical Magazine*.

The **New York Electrical Society**, a pioneer in presenting popular lectures on scientific subjects to New York audiences for 72 yr, has dissolved and turned over its remaining assets to The Cooper Union. R. Karl Honaman, president of the Society, recently presented a check to Edwin S. Burdell, president of The Cooper Union, for the sum of $4040.43 at simple ceremonies marking the final act of the organization formed in 1881. The money will be used to follow the aims of the old organization through lectures at the Cooper Union Forum.

John T. Edsall, chairman of the Committee on International Relations of the American Academy of Arts and Sciences, has submitted a letter to the House Judiciary Committee which includes the following statements relating to the **visa problems** of foreign visitors to the United States [*Science* **119**, 3A (Mar. 19); and **119**, 498 (Apr. 16)]:

> The Council of the American Academy of Arts and Sciences on recommendation of its Committee on International Relations voted unanimously at its April meeting to give strong support to the Gubser Resolutions, H.J. Res. 307 and 308, especially the latter. The aim of both these resolutions is to encourage the visits of foreign experts in science and other fields of scholarship, by simplifying and accelerating the process of obtaining a temporary visa. . . .
>
> There is much evidence that the scientific and cultural life of this country is suffering from the lack of adequate contacts with our foreign colleagues because of difficulties which so many of them experience when they wish to visit this country. The most obvious evidence of this is found in the increasing tendency to hold international scientific meetings outside of the United States, because of the difficulty of holding them here. . . .
>
> The present unsatisfactory state of affairs is damaging to the United States in at least two ways. First, it arouses antagonism to this country, and sharp criticism of our political methods, among a great number of the intellectual leaders in the countries of western Europe and in other countries which are generally to be regarded as our friends. This is a serious matter, with great political significance. These intellectual leaders have profound influence in their countries; their words are listened to with attention by their governments and by the people at large. If our policies antagonize them and make them suspicious, we are doing direct harm to American foreign policy as well as to international cultural relations. In the second place, by interfering so gravely with the visits of foreign scholars to this country, we are actually weakening the state of national defense. A strong and healthy development of science is an indispensable element of national strength in the world of today. By obstructing the free interchange of ideas between the leading scientists of foreign countries and of our own, we are obstructing our own scientific progress and actually endangering our national security. . . .

The National Geographic Society, the National Museum of Canada, and the Smithsonian Institution are sponsoring an **expedition to Southampton Island** in Hudson Bay this summer. It will be headed by **Henry B. Collins, Jr.**, of the Smithsonian, who has carried on many archeological studies in the Arctic. The island offers a spectacular concentration of ruins of different types, including 75 old stone and whalebone houses, believed to be unique in Canada. The expedition plans to study three cultures, the Dorset, Thule, and Sadlermiut.

Scientists in the News

Harvard University has announced the appointment, effective July 1, of two men who have served on the University of Chicago faculty—**Konrad Bloch** as Higgins professor of biochemistry, and **Frank H. Westheimer** as professor of chemistry.

Percy Williams Bridgman, Higgins University Professor of Physics at Harvard University, will retire at the end of the academic year. As student and teacher, Prof. Bridgman has been at Harvard for 54 yr. He is known for his pioneering research in high pressure phenomena and electrical conduction in metals, and for his contributions to thermodynamics and the methodology of science. He has written 10 books and innumerable papers, and his work has brought him many honors, including the 1946 Nobel Prize in physics.

Prof. Bridgman entered Harvard College in 1900, received the A.B. degree in 1904, the A.M. in 1905, and the Ph.D. in 1908; he has taught at Harvard since then. In 1926 he was appointed to the Hollis Professorship of Mathematics and Natural Philosophy, the second oldest endowed professorship in the university, dating back to 1727. In 1951 he was named a University Professor, in which capacity he could teach and carry out research in any department or school of the university.

In addition to the Nobel Prize, Prof. Bridgman has received the Rumford Medal of the American Academy of Arts and Sciences, the Cresson Medal of the Franklin Institute, the Roozeboom Medal of the Royal Academy of Sciences of Amsterdam, the Comstock Prize of the National Academy of Arts and Sciences, and the Research Corporation Award. Harvard, in 1939, awarded him an honorary degree of Doctor of Science with the citation: "An experimentalist who transforms stubborn matter by high pressure; a logi-

cian who alters physical theory by acute analysis."

For 50 yr Prof. Bridgman has been investigating the changes that occur in various materials when they are subjected to high pressure. By the use of new techniques, he has increased available laboratory pressures almost 100 times. His career in the realm of high pressures represents one of the few examples in physics of a "one-man" development of an important field of research. For most purposes, anyone interested in the properties of matter under pressures of more than 10^5 lb/in.^{2} can confine his attention to Prof. Bridgman's papers. Further, the number of original measurements of physical properties that he has published has few parallels. These include measurements of compressibility of solids, liquids and gases; viscosity of liquids under pressure; electrical and thermal conductivities under pressure; thermoelectric effects; and the determination of melting curves, plasticity, and fracture under pressure. All this was done in a pressure range for which he had to design the equipment and develop the measuring processes.

Prof. Bridgman has developed a method of growing large, single crystals that the optical industry now uses to obtain transparent material with optical properties different from those available with glass. One of the by-products of his research has been a new method of strengthening the barrels of military cannon. Developed to increase the resistance of experimental pressure chambers, this method is now commonly used in the manufacture of large gun barrels.

During World War II Prof. Bridgman made various investigations for the Government on the effect of pressure in increasing the ductility and resistance to fracture of steel. Only last year he reported experiments in which high pressures were used to produce new alloys. To produce a new bismuth-tin alloy, a pressure of 4.5×10^5 lb/in.^{2} was used.

John C. Briggs of the Natural History Museum of Stanford University, who is preparing a world monograph of the fishes of the order of Xenopter, has recently returned from a round-the-world trip made for the purpose of studying clingfish material. Among the ichthyological centers visited were those of Sydney, Calcutta, Paris, and London.

Leonard Carmichael, secretary of the Smithsonian Institution, was appointed by Secretary of State Dulles to serve as chairman of the American delegation to an intergovernmental "Conference on the protection of cultural property in the event of armed conflict." The meetings of the conference began at The Hague, Netherlands, on Apr. 21. The delegates are to prepare an international agreement for the protection of cultural property, such as buildings or even whole urban areas which are declared to be cultural or historic monuments, as well as movable works of art or scientific collections.

Oliver W. Cass, assistant laboratory manager of the Du Pont Company's electrochemicals department at Niagara Falls, N.Y., whose pioneering research has contributed to the development of nylon, DDT, and synthetic rubber, has won the 1954 Jacob F. Schoellkopf Medal of the American Chemical Society's Western New York Section.

Russell L. Cecil, eminent physician and author of *Textbook of Medicine,* has been named national medical director of the Arthritis and Rheumatism Foundation, New York, succeeding **Gideon K. de Forest,** who has filled the post for 4 yr. Dr. de Forest will continue as associate medical director, which will allow him to devote more time to the Yale University School of Medicine where he is chief of the arthritis clinic and associate professor of clinical medicine. Dr. Cecil will divide his time equally between private practice and the Foundation.

In September, **Randolf Wallace Chapman,** formerly of Johns Hopkins University, will succeed **Edward L. Troxell** as chairman of the Geology Department at Trinity College.

K. K. Chen, director of pharmacologic research at Eli Lilly and Company, recently received the Rho Chi Citation at the Philadelphia College of Pharmacy and Science and delivered the second annual Julius W. Sturmer Memorial Lecture on the subject "From digitalis to corchoroside." He was honored for his achievements in pharmacology over the past 30 yr, among them being the introduction of ephedrine and the development of an effective antidote for cyanide poisoning.

On May 20, the 1954 Honor Scroll of the New York Chapter of the American Institute of Chemists will be presented to **Hans Thacher Clarke,** professor of biochemistry and head of the department at the College of Physicians and Surgeons, Columbia University.

Karl T. Compton, a member of the Atomic Energy Commission panel and former president of the Massachusetts Institute of Technology, has received Dickinson College's annual Priestley Memorial Award of $1000 and a ceramic medallion of Joseph Priestley.

The Blakiston Company, Inc., has announced the development of the Blakiston Publications in the Plant Sciences and the appointment of **Hiden T. Cox** as consulting editor. Dr. Cox, associate professor of botany at the Virginia Polytechnic Institute, is at present on leave to serve as deputy executive director of the American Institute of Biological Sciences in Washington.

William N. Fenton, anthropologist and executive secretary of the Division of Anthropology and Psychology of the National Research Council, has been appointed director of the New York State Museum and State Science Service, effective July 1.

Harvard University has announced the appointments of **Sydney Goldstein** and **Eugene G. Fubini** as

the first two Gordon McKay visiting lecturers on applied science. Dr. Fubini will be in residence for the first half of the academic year 1954–55, and Dr. Goldstein for the entire year. Dr. Goldstein, who has an international reputation for research in fluid mechanics, is vice president of the College of Technology in Haifa. Dr. Fubini is supervising engineer of the Special Devices Section of the Airborne Instruments Laboratory, Mineola, N.Y.

Two Philadelphia physicians have been appointed, effective July 1, to positions as chairmen of departments in the Graduate School of Medicine of the University of Pennsylvania. **Herbert R. Hawthorne,** professor of surgery and chief of the Surgical Service at Graduate Hospital and at the American Hospital for Diseases of the Stomach, will succeed **William Bates** as chairman of the Department of Surgery. **Joseph P. Atkins,** clinical professor of bronchology, esophagology, and laryngeal surgery and a member of the staff of five hospitals in the Philadelphia and Camden area, will succeed **Gabriel Tucker** as chairman of the Department of Bronchology, Esophagology and Laryngeal Surgery. Dr. Bates and Dr. Tucker plan to remain active in teaching programs and in clinical activities.

Mervin J. Kelly, president of Bell Telephone Laboratories, has received the Industrial Research Institute's 1954 Medal. The medal is presented annually "to recognize and honor outstanding accomplishment in leadership in or management of industrial research which contributes broadly to the development of industry or the public welfare."

Leo Korchin, Georgetown University instructor in oral surgery, has been named winner of the 1954 Novice Award of the International Association for Dental Research for his report, "An investigation to determine the effect of starch sponge implanted in bone." The award is given for the best first paper submitted on research.

N. B. Kurnick, formerly of Tulane University Medical School, has been appointed associate clinical professor of medicine at the University of California at Los Angeles. He is also on the staff of the Veterans Administration Hospital in Long Beach. Dr. Kurnick will continue clinical work and investigations on the biochemistry of nucleic acids and nucleotic enzymes.

Morris M. Leighton, for 31 yr chief of the Illinois State Geological Survey, will retire on July 1 to give his full time to research on the Pleistocene geology of Illinois. He will be succeeded by **John C. Frye,** state geologist and professor of geology at the University of Kansas. During Dr. Leighton's tenure the offices and laboratories of the State Geological Survey, some 40 in number, have been housed in the new $2,500,000 Natural Resources Building on the campus of the University of Illinois.

Horace W. Magoun, professor of anatomy in the School of Medicine, University of California at Los Angeles, recently delivered the James Arthur Lecture on the evolution of the human brain at The American Museum of Natural History. His subject was "Regulatory functions of the brain stem."

Augustine R. Marusi, formerly vice president in charge of Eastern operations of the Borden Company's Chemical Division, has succeeded **William F. Leicester** as president of the division. Mr. Marusi will have charge of plants in 13 cities, the company's Brazilian operations, and the General Research Laboratory in Philadelphia. Mr. Leicester continues as chairman of the division's directing board and as a vice president of the company.

Kirtley F. Mather, professor of geology at Harvard University and former president of the AAAS, will retire at the end of the academic year. Prof. Mather, who is also curator of the Geological Museum at Harvard, has been on the faculty since 1924. He has written extensively on the world-wide utilization of natural resources and is an authority on petroleum geology. He is known for his geologic studies of the Rocky Mountains in Colorado, and the Andes in Bolivia. For 8 yr director of the Harvard Summer School, he is a past president of both the Boston Center for Adult Education and the Adult Education Council of Boston. From 1946 to 1948 he was President of the National Council of YMCA's of the United States.

He received his B.S. degree from Denison University in 1909 and the Ph.D. from the University of Chicago in 1915. He taught at the University of Arkansas, Queens University, Canada, and Denison University before joining Harvard faculty as an associate professor in 1924. He was promoted to professor in 1927. He has been a member of the Faculty Committee on General Education since 1946 and for the last 6 yr has taught a general education course on the "Impact of science on modern life."

Among books written by Professor Mather are *Old Mother Earth, Science in Search of God, Sons of the Earth, Source Book in Geology* (with S. C. Mason), *Adult Education, A Dynamic for Democracy* (with Dorothy Hewitt), *Enough and To Spare,* and *Crusade for Life.*

On May 6 **Thomas Parran,** dean of the Graduate School of Public Health at the University of Pittsburgh, delivered the Cutter Lecture on Preventive Medicine at the Harvard School of Public Health on the subject, "Contributions of public health to the control of chronic disease."

Harry E. Warmke has been appointed officer in charge of the Federal Experiment Station, Mayaguez, Puerto Rico. He has replaced **Kenneth A. Bartlett,** who resigned to accept the presidency of the Virgin Islands Corporation in St. Croix. **Thomas Theis** has been named assistant officer in charge. The Federal Experiment Station was founded in 1901 and serves as a tropical research outpost of the U.S. Department of Agriculture.

Education

Berea College, Berea, Ky., has recently dedicated its completed Science Building, the first portion of which was erected in 1928 when the college enrollment was 460. Now the enrollment has risen to 1100, necessitating the new $485,000 addition and equipment. The addition consists of two wings, increasing the facilities of the classrooms, laboratories, and offices of all the science departments—physics, geology, biology, and chemistry.

Case Institute of Technology has announced that reservations are being accepted for a **Short Course on Operations Research** to be held June 7–18. The course is sponsored by the Operations Research Group of the Department of Engineering Administration. Research experience and sufficient knowledge of mathematics to understand mathematical symbolism is required of registrants. Registration is limited and candidates will be accepted in the order in which their applications are received.

Wayne University has announced that it is the first American university to establish a **department of industrial medicine;** such training will be made an integral part of the education of every one of the university's medical students. Arthur J. Vorwald, internationally known pathologist and former director of the Edward L. Trudeau Foundations in Saranac Lake, N.Y., is to head the new department, which will begin active operation in the fall.

The Department of Chemical and Metallurgical Engineering of the University of Michigan College of Engineering will offer an intensive course, **"The design of distillation and absorption equipment,"** from July 12 to 23. The course is intended for practicing engineers and will provide a working knowledge of fundamental principles. It will cover such subjects as tray layout and hydraulics, azeotropic and extractive distillation, vapor-liquid equilibrium, and tray calculations. Roger H. Newton of the Badger Manufacturing Company will join Robert R. White and Brymer Williams of the university faculty in presenting the course. Registration forms may be obtained from the Department of Chemical and Metallurgical Engineering, 2028 East Engineering Bldg., Ann Arbor.

Purdue University will hold its 7th annual **Industrial Microbiology Institute,** June 6–12. The institute was designed to bring to enrollees a familiarity with the important industrial molds and the latest information concerning culture and control. The course should be of interest to industries using fungi in their productive capacities, to students needing refresher information, and to scientists generally who want to know enough about the subject of mycology to understand and to evaluate the increasing volume of literature dealing with fungi.

A one-week police science workshop for law enforcement officers will be given June 21–26 at Western Reserve University. The **Institute on Science in Law Enforcement** will be sponsored by the new Law-Medicine Center established this winter in cooperation with the Cuyahoga County (Cleveland) Coroner's Office. A faculty of 32 experts representing all phases of police science will lead the lectures, demonstrations, and discussions.

Donald L. Buchanan, director of the Radioisotope Unit of the West Haven Veterans Administration Hospital, West Haven, Conn., has been appointed lecturer in biochemistry at the Yale University School of Medicine, where he has introduced a new course, **"Isotopes in biochemical research,"** during the spring semester.

A course in **medical testimony in malpractice and negligence cases for practitioners of medicine, law, and allied professions** will be given for the first time by New York University-Bellevue Medical Center's Post-Graduate Medical School in cooperation with New York University School of Law. Under the direction of Maxwell H. Poppel, professor and chairman of the Department of Radiology, NYU College of Medicine, sessions will be held every Thursday evening from Oct. 7, 1954, through Mar. 10, 1955. Emphasis will be placed on the radiologic as well as the legal and other aspects and pitfalls of medical tesimony in malpractice and negligence cases. Mock trials, question-and-answer periods, and other practical features simulating actual court conditions will be presented. Members of the Department of Radiology, judicial experts, and qualified officials will participate.

As a major step toward consolidating its rapid growth, the **Polytechnic Institute of Brooklyn** has contracted to purchase for $2,000,000 the eight-story, block-long plant of the American Safety Razor Corporation in downtown Brooklyn. Acquisition of the building, located on Jay St. between Johnson St. and Myrtle Ave., will enable Polytechnic to bring its widely dispersed facilities together in one suitable modern structure

It cannot yet be determined when the Institute will move into the new quarters; the date depends upon a number of factors, particularly the success of efforts to raise the required funds from alumni, friends, and corporations. A campaign for $3,500,000 will be launched under the chairmanship of Carl Whitmore, former president of the New York Telephone Company and a member of the Institute's board of directors. The additional $1,500,000 will be required to adapt the plant for education purposes and to purchase adjacent properties along Jay St. The latter will be the site for a proposed new library and student lounge.

According to Lewis M. Terman, emeritus professor of psychology, Stanford University, a study of 18,000 scientists listed in *American Men of Science,* who got their bachelor's degree between 1924 and 1934, showed that it is not the great university but the small

liberal arts college that has the best **record of turning out scientists.** Reed College in Portland, Ore., topped the list with 132 per thousand graduates. The only technological school in the top 12 was the California Institute of Technology, which was second with an index of 70. Kalamazoo College was third with 66, Earlham (Richmond, Ind.) fourth with 57, and Oberlin fifth with 56. Only a half dozen of the great universities were in the top fifty.

Wayne University dedicated its new Medical Science Building on May 11. The new structure provides physical facilities permitting an enrollment increase from 260 to 400 students. Built with a $3,550,000 state grant and almost $900,000 from the Detroit Board of Education, Wayne's governing body, the building will supply long-needed lecture halls and laboratory facilities for the school. The eight-story, gray brick structure was partially occupied and in use earlier this year. Another major wing of the building will be constructed at a later date.

Grants and Fellowships

A fellowship grant of $12,000 from the **Colgate-Palmolive-Peet Company** of Jersey City to **Rutgers University** has been announced. The money will be used to support three graduate fellowships in chemistry, each providing $2000/yr for a 2-yr period.

Five scientists have been named by Bell Telephone Laboratories to receive the **Frank B. Jewett postdoctoral fellowships** for 1954–55: Stanley Deser of the Institute for Advanced Study; Thomas Fulton of Harvard University; Stanley L. Miller of the University of Chicago; Roger G. Newton of the Institute for Advanced Study; and Richard S. Pierce of Harvard University. Three are physicists, one a mathematician, and the fifth a chemist. Dr. Newton and Dr. Pierce were among the award winners last year.

Grants for the fellowships were established in 1944 by the American Telephone and Telegraph Company, upon the retirement of the late Dr. Jewett as vice president in charge of development and research. The awards this year provide $4000 to each fellow and an additional $1500 to the academic institution selected for his research.

The **Link Foundation,** which was established last December to make grants that will advance scientific, technological, general educational, and charitable projects—and more specifically, advance training and education in aeronautics—announced the following four grants:

Norwich University, Northfield, Vt., for scholarships to teachers enrolled in the school's 1954 Summer Aviation Education Workshop.

The University of Illinois Foundation, to provide flight experience for a selected group of high school teachers, and to prepare a suggested curriculum guide for training aviation personnel.

The University of Nebraska, to provide scholarships to elementary school teachers attending the university's Teachers' Workshop and for the preparation of educational materials.

The National Fund for Medical Education, Inc., for research in aviation medicine.

The headquarters of the Link Foundation will be established in Washington in association with the National Air Museum of the Smithsonian Institution.

Ohio State University has announced the following 12 research contracts, totaling $348,926:

Radio Corporation of America, Camden, N.J. Superturnstile antenna, $16,345.

Godfrey L. Cabot, Inc., Boston. Application of Wollastonite in ceramic field, $15,634.

Air Research and Development Command, Lackland Air Force Base, San Antonio, Tex. Development of improved methods for evaluating the effectiveness of RB-47 crews, $70,000.

Wright Air Development Center, Wright-Patterson Air Force Base, Dayton, Ohio. Microwave oscillator tubes, $35,000; heat transfer within rotating electrical equipment, $29,991; fuming nitric acid containers and kinetics of the decomposition of fuming nitric acids, $25,000.

Department of the Navy, Office of Naval Research, Washington, D.C. Literature search, nitro compounds, $5000.

Rome Air Development Center, Rome, N.Y. Effects of direction of polarization, $17,500; high powered infra-red source, $28,186.

Laboratory Procurement Office, Signal Corps Supply Agency, Fort Monmouth, N.J. Transmitting and receiving antenna vehicular, $24,972; antenna phenomena research, $51,298.

Department of the Army, Engineer Center, Fort Belvoir, Va. Basic factors limiting the accuracy of mapping, $30,000.

The **University of Wisconsin** has received $33,091.46 for cancer research from the estate of the late Mabel C. Pratt of Beloit.

The **Yale University School of Medicine** will receive from the Victoria Fund a gift of $50,000 annually over a period of 5 yr in support of teaching, research, and patient care in the field of cardiovascular disease. William W. L. Glenn, associate professor of surgery in charge of the Section of Cardiovascular Surgery and Herbert S. Harned, Jr., assistant professor of Pediatrics, have been designated to fill the faculty posts supported by the gift and will work closely with A. V. N. Goodyer, R. Whittemore, and others in developing the study program. The Victoria Fund was founded by Hendon Chubb, Yale 1895, who has made several other substantial gifts to the university.

Meetings and Elections

The 8th annual meeting of the **American Electroencephalographic Society** will take place at the Hotel Claridge, Atlantic City, N.J., June 11–13, immediately preceding the annual meeting of the American Neurological Association. Both scientific and business sessions will be held on June 11, and that evening there will be a special session on the medico-legal aspects of clinical electroencephalography, with A. Earl Walker as moderator. The annual banquet is scheduled for June 12.

A symposium on "The Rhinencephalon," under the chairmanship of Robert Schwab, will be held on June 13. Committee and council meetings are scheduled for the 10th and the morning of the 11th.

AAAS members are cordially invited to attend the **Fifth Alaska Science Conference,** Sept. 7–10, sponsored by the Alaska Division of the AAAS. These annual meetings are devoted to problems applicable to Arctic and sub-Arctic scientific endeavor. To contribute a paper, immediately send the chairman of your Section a tentative title and a brief note on the subject matter. Subsections and subsection chairmen will be assigned on the basis of the interest indicated.

The section chairmen are: agriculture and forestry, Curtis Dearborn, Agricultural Experiment Station, Palmer, Alaska; engineering, William B. Page, Arctic Health Research Center, Box 960, Anchorage; biological sciences, Brina Kessel, University of Alaska, College, Alaska; public health and medicine, Edward Blomquist, Arctic Health Research Center, Box 960, Anchorage; physical sciences, Robert Knecht, National Bureau of Standards, Box 1861, Anchorage; social sciences, Willeta Matsen, Arctic Health Research Center, Box 960, Anchorage.

The **16th Midwest Regional Meeting of the American Chemical Society** will be held in Omaha, Nov. 4–6. The general chairman is Willard M. Hoehn of G. D. Searle and Company, Chicago. Sessions have been tentatively scheduled for agricultural and food, analytical, biological, industrial and engineering, medicinal, organic, and physical and inorganic chemistry; and also for chemical marketing and economics, and chemical education. Several other divisions may be added if there are sufficient papers.

This meeting is being held in conjunction with Omaha's Centennial Celebration, and the Omaha Section of the ACS will supervise a month-long atomic energy exhibit during November at the Joslyn Memorial Art Museum.

The Astronomy Department of the University of California in Berkeley will arrange an **astronomy conference** between Aug. 12 and Sept. 11 for college and university instructors and other qualified persons. This conference will be held under the auspices of the National Science Foundation and the Extension Division of the University of California. The purpose is to acquaint instructors with modern developments in the fields of astronomy and astrophysics. Membership will be limited to about twenty. The National Science Foundation will pay travel and subsistence expenses. The principal lecturer will be Bart J. Bok of Harvard University, who will discuss the structure of our galaxy. There also will be lectures on problems of the sun and of stellar physics. The participants will be encouraged to take an active part in all discussions. Applications should be sent to the Department of Astronomy, Univ. of Californin, Berkeley, *before June 15.*

Seven hundred electrical technical experts from 29 countries and the U.S. will attend the 50th anniversary meeting of the **International Electrochemical Commission** (IEC) to be held at the University of Pennsylvania, Sept. 1–16. The IEC was founded in St. Louis in 1904 with Lord Kelvin (Sir William Thomson) of England as first president; however, the only meeting ever held in this country took place in New York in 1926. Harold S. Osborne, formerly chief engineer, American Telephone and Telegraph Co., is IEC president; Richard C. Sogge, General Electric Co., is president of the U.S. National Committee of IEC; and P. H. Chase, Philadelphia Electric Co., is chairman of the General Committee in charge of arrangements. The American Standards Association is the group through which U.S. participation in the event is being carried out. The meetings are being made possible by funds contributed by American industry, particularly in the electrical and allied fields. Chairman of the finance committee is Walker Cisler, president of the Detroit Edison Company.

The delegates will hold 226 morning and afternoon sessions in which they will work on international standards in the fields of electric light, power, and communications. About 300 of those attending will come from foreign countries. The work of the IEC is carried on by 37 technical committees, 26 of which will hold sessions in Philadelphia. The work covers the entire field of the electrical art and includes such specific committee subjects as dimensions of motors, standard voltages, current ratings and frequencies, overhead lines, safety, insulating materials, and electronic tubes. The United States heads five of the committees: steam and hydraulic turbines, internal combustion engines, letter symbols and signs, and lightning arrestors.

The Philadelphia meetings will include an all-day Jubilee celebration on Sept. 9 commemorating 50 yr of IEC. Speakers will be Lord Waverly, chairman of the Port of London Authority and past president of the British Standards Institution; Haakan Sterky, head of the Swedish communication system; Pierre P. Ailleret, director of Electricité de France; and Lee A. DuBridge, president, California Institute of Technology. A banquet in the Bellevue Stratford Hotel will be held that evening.

The **National Academy of Sciences** at its 91st Annual Meeting in Washington, D.C., elected a president, a foreign secretary, 2 members of the Council, 30 members, and 3 foreign associates.

Detlev W. Bronk, president of the Rockefeller Institute for Medical Research, was reelected president for a 4-yr term, beginning July 1. Dr. Bronk has served as president of the Academy since July 1, 1950.

John Gamble Kirkwood, director, Sterling Chemistry Laboratory at Yale University, was elected foreign secretary for a 4-yr term, beginning July 1. Dr. Kirkwood succeeds Roger Adams of the University of Illinois.

Other officers of the Academy, all of whom are members of the Council, are: vice pres., George W. Corner; home sec., Alexander Wetmore; treas., William J. Robbins.

Farrington Daniels of the Department of Chemistry at the University of Wisconsin, and Merle A. Tuve of the Department of Terrestrial Magnetism at the

Carnegie Institution of Washington, were elected to membership on the Council to serve until June 30, 1957. Additional members of the Council are Hugh L. Dryden, Robert F. Loeb, William W. Rubey, Wendell M. Stanley, and Edwin B. Wilson.

New members

Edgar Anderson, professor of botany, Washington University.

H. W. Babcock, astronomer, Mount Wilson Observatory.

Edgar Collins Bain, vice president in charge of research and technology, U.S. Steel Corporation, Pittsburgh.

Arnold Kent Balls, professor of enzyme chemistry, Purdue University.

John Bardeen, professor of physics and electrical engineering, University of Illinois.

William Bloom, professor of anatomy, University of Chicago.

M. N. Bramlette, geologist, Scripps Institution of Oceanography.

Wallace R. Brode, associate director, National Bureau of Standards.

Melvin Calvin, professor of chemistry, University of California.

Britton Chance, director, Johnson Foundation, University of Pennsylvania.

Richard Phillips Feynman, professor of theoretical physics, California Institute of Technology.

Hermann O. L. Fischer, professor of biochemistry, University of California, Berkeley.

J. B. Fisk, director of research in the physical sciences, Bell Telephone Laboratories, Murray Hill, N.J.

J. P. Guilford, professor of psychology, University of Southern California.

Nathan Jacobson, professor of mathematics, Yale University.

George E. Kimball, professor of chemistry, Columbia University.

Willis E. Lamb, professor of physics, Stanford University.

Eugene Markley Landis, professor of physiology, Harvard Medical School.

Ernst Mayr, professor of zoology, Harvard University.

William F. Meggers, chief, Spectroscopy Section, National Bureau of Standards.

Alfred E. Mirsky, member, Rockefeller Institute for Medical Research.

Brian O'Brien, vice president, American Optical Company, Southbridge, Mass.

Wolfgang K. H. Panofsky, professor of physics, Stanford University.

Alexander Petrunkevitch, professor emeritus of zoology, Yale University.

Arnold R. Rich, professor of pathology, School of Medicine, Johns Hopkins University.

Julian H. Steward, professor of anthropology, University of Illinois.

Ernest H. Vestine, chairman, Section on Statistical and Analytical Geophysics, Department of Terrestrial Magnetism, Carnegie Institution of Washington.

F. H. Westheimer, professor of chemistry, University of Chicago.

Ralph H. Wetmore, professor of botany, Harvard University.

Albert E. Whitford, professor and director, Washburn Observatory, University of Wisconsin.

Foreign associates

Frank Macfarlane Burnet, director of the Walter and Eliza Hall Institute for Medical Research, Melbourne, Australia.

Albert M. G. R. Portevin, consulting engineer, Paris, France.

Otto Renner, professor and head, Botanical Institute and Garden, Munich, Germany.

The fifth annual Interfaith Conference on the Coming Great Church, July 31–Aug. 7, will have as its theme **"Religion in the age of science."** The meeting will take place on Star Island, Isles of Shoals, which is 10 mi out of Portsmouth, N.H. The conference is under the auspices of an autonomous committee that is nondenominational. "It is the conviction of the program committee that the Coming Great Church will arise out of a new and universally valid synthesis of religious doctrine in which the universally acceptable approach to truth established in the sciences will be a crucial source of inspiration and insight." In preceding years the conference emphasized the points of view of particular religious groups; this year the scope will be broadened to explore, with the leadership of outstanding scientists, the problems of religion in the age of science. The participating scientists have been asked to present their thinking in three areas of concern to religion: the nature of truth and reality; the nature of the cosmos; and the nature of man. Discussion groups will seek to integrate scientific and religious points of view.

Some of the famous scientists of history and their impact on religion will be the theme of the daily chapel talks by the conference chaplain, Edwin P. Booth. The schedule calls for two or three formal lectures or panel discussions per day, and also informal discussion and book-review sessions. There will be opportunity for all to ask questions of the scientists, philosophers, and theologians. The list of speakers includes: Karl W. Deutsch, professor of history at M.I.T.; Edwin P. Booth, professor of historical theology, Boston University; C. J. Ducasse, professor of philosophy, Brown University; Philipp Frank, lecturer on physics and mathematics at Harvard; Edwin C. Kemble, professor of physics at Harvard; Gerlad Holton, physicist at Harvard; Henry Margenau, professor of physics at Yale; Harlow Shapley, lecturer on cosmography at Harvard, and for over 30 years director of the Harvard Observatory; George Wald, professor of biology at Harvard, specialist in the biochemistry of living processes; Roy G. Hoskins, formerly

director of research, Memorial Foundation for Neuro-Endocrine Research, Harvard Medical School, and the Worcester State Hospital; H. B. Phillips, formerly head of the department of mathematics, M.I.T.; B. F. Skinner, professor of psychology at Harvard.

Because the number of conferees is limited to a total of 180, interested persons are urged to register immediately. For details, write to the Star Island Corporation, 355 Boylston St., Boston 16.

A combined meeting of the **Second World Congress of Cardiology** and the **27th Scientific Sessions of the American Heart Association** will take place in Washington, D.C., Sept. 12–17. This will be the first international medical gathering of its kind to be held in the United States. (The first World Congress of Cardiology was held in Paris in September 1950). Papers will be presented in English, French, and Spanish, and will constitute one of the most comprehensive programs relating to heart and blood vessel diseases ever presented.

Chairman of the organizational committee is Paul D. White, executive director of the National Advisory Heart Council and consultant in medicine at Massachusetts General Hospital, Boston. For further information address inquiries to L. W. Gorham, Sec.-Gen., Second World Congress of Cardiology, American Heart Association, 44 East 23 St., New York 10.

The **South Carolina Academy of Science** held its 27th annual meeting in joint session with the Western Carolinas Section of the American Chemical Society and with the South Carolina Section of the Southern Society for Philosophy and Psychology on Apr. 10, at Wofford College, Spartanburg. President J. E. Copenhaver of Sunoco Products Company presided. Seven papers were presented at the General Morning Meeting; and 13 papers were given at the Biology Section, 8 at the Chemical Section, and 4 at the Philosophy and Psychology Section. The Academy sponsors a Science Talent Contest for high school students for which awards were given.

The following officers were elected for 1954: pres., Elsie Taber, Medical College of S.C.; v. pres., G. M. Armstrong, Clemson; sec.-treas., Harry W. Freeman, Univ. of S.C.

A **symposium on multivariate statistical analysis** was held at the University of North Carolina, Apr. 21–24, the first sessions at Chapel Hill and the final one at Raleigh. Some 35 statisticians, psychologists, and economists attended. The formally announced participants were Maurice G. Kendall, C. Radhakrishna Rao, Harold Hotelling, S. N. Roy, R. C. Bose, R. L. Anderson, Aleyamma George, Seymour Geisser, and Earl Diamond, but a number of others also contributed. Each lecture was followed by extensive discussion. Much unpublished material and many new ideas were brought to light in fields such as factor analysis, multicollinearity, discriminant functions and related classification problems, basic criteria for multiple-parameter estimation, canonical correlation, serial correlation, T statistics, and multivariate confidence bounds.

The **1954 Teaching Institute of the Association of American Medical Colleges** will focus on pathology, microbiology, immunology, and genetics. The first institute, held at Atlantic City in October 1953, covered the areas of physiology, biochemistry, and pharmacology. Douglas H. Sprunt, professor of pathology at the University of Tennessee is chairman and Robert A. Moore, vice-chancellor of the University of Pittsburgh is cochairman of this year's institute, which will take place Oct. 10–15. The Coordinators of Cancer Teaching will participate and then will hold their own meeting Oct. 15–16. The annual meeting of the Association will follow on Oct. 17–20. All meetings will be at the French Lick Springs Hotel, French Lick, Ind.

The objectives of the teaching institutes are to provide an opportunity for medical educators to discuss important teaching problems, to review current experiments in medical education, to exchange philosophies and experiences, and to make any suggestions that might improve the effectiveness of medical teaching and the educational opportunities offered to medical students.

Attendance will be by invitation only and will be limited to 120 participants, which will include one teacher from each of the 95 medical schools in the United States, Canada, Puerto Rico, and the Philippines. The total group will represent a balance among the several disciplines and areas to be explored. In advance of the institute, medical school participants will collect background information and opinions from their colleagues for the use of committees in planning topics for discussion. The institute will be a working conference functioning through informal discussion groups of 10 to 15 persons.

Miscellaneous

William R. Amberson of the University of Maryland School of Medicine has announced that on Apr. 20 contributions to the **Edwin Grant Conklin Memorial Fund** had reached $3254.50. The Committee is now circulating a final appeal for funds to support the program at the Marine Biological Laboratory, Woods Hole, in honor of Dr. Conklin, who was a past president of the AAAS. Checks may be sent to the treasurer, Mr. Homer P. Smith, at MBL.

The United States Civil Service Commission has announced a **technologist examination** for filling positions paying $4205 to $10,800 a year, in the Washington, D.C., area. The positions cover a wide variety of products and processes. To qualify, applicants must have had appropriate education or experience. No written test is required. Information and application forms may be secured at many post offices or from the U.S. Civil Service Commission, Washington 25, D.C.

Technical Papers

Time-Intensity Factor in the Production of Dicentric Bridges with Gamma Rays of Radium during Meiosis in the Grasshopper, *Gesonula punctifrons*

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A large number of dicentric bridges are observed in the first anaphase of meiosis, when the resting cells of the primary spermatocytes of the grasshopper, *Gesonula punctifrons* (*1–3*), are treated with moderate doses of x-rays. These bridges (Fig. 1) are morphologically indistinguishable from those produced as a result of crossing over within relatively inverted segments of chromosomes. Ray-Chaudhuri and Sarkar (*3*) have, however, found the frequency of dicentric bridges in meiosis to be directly proportional to the dose of x-rays, tested within the range of 40 to 320 r units. In view of these findings, they concluded that the experimentally produced bridges in *Gesonula* are not the result of crossing over within an inversion, since the production of an inversion requires at least two independent breaks, but that, instead, they originated from a single break in a meiotic chromosome or, less probably, from nearby breaks produced in two chromatids by the track of one and the same ionizing particle.

A reliable test for the single unit type of action of radiation is to find whether the effect of a given dose is independent of the manner in which the ionizations are distributed in time. The present series of experiments was designed to find the effect of varying the intensity (dose-rate) of treatment on the frequency of dicentric bridges in the same material (*4*).

In this, as well as in the previous study conducted by Ray-Chaudhuri and Sarkar (*3*), adult males of *Gesonula punctifrons* were used as the experimental material. In each of the five experiments carried out, the grasshoppers were divided into two equal lots; one lot was irradiated for 30 min and was kept during irradiation in a rectangular cardboard box 4 by 2 by 1 cm in size, and two radium needles of 50 mg each were kept at a distance of 2 cm from the middle of the box. The other lot was treated for 23 hr and was kept in an annular box 1 cm wide and 2 cm high, with a mean radius of 10 cm. Two radium needles of 21 mg each were placed at the center of the box. Under these conditions of radiation, the calculated dosage for both lots of grasshoppers was 81.6 r units. Thus, a difference in intensity amounting to 46 times was produced between the high- and low-intensity lots. The testes were fixed 30 hr after the completion of irradiation in each case, and results were scored from temporary acetocarmine preparations.

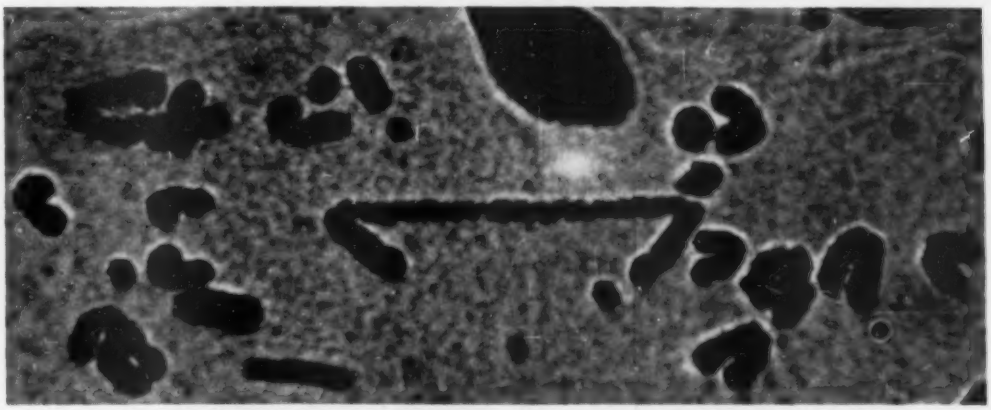

Fig. 1. Photomicrograph of a typical dicentric bridge with fragment; 80 r (high intensity).

In all five experiments, a total of 9679 first anaphase cells were examined and 408 bridges were recorded, from 90 treated grasshoppers. The results are summarized in Table 1. It will be clear from the table that the frequencies of bridges are remarkably similar in all five experiments, both in the high- and low-intensity lots. The differences in the percentage of bridges produced after high- and low-intensity irradiations, either in the individual experiments or in the total of all experiments, are insignificant. We, therefore, conclude that this particular type of radiation-induced effect in *Gesonula* is independent of the intensity of radiation within the limits of the experiments.

The results of the present series of experiments, coupled with the fact that the frequencies of bridges are in direct proportion to the x-ray doses, further

Table 1. Frequency of dicentric bridges 30 hr after irradiation in different high- and low-intensity experiments with 80 r of gamma rays.

Expt	High intensity			Low intensity		
	First anaphase cells	Bridges	Percentage	First anaphase cells	Bridges	Percentage
I	384	15	3.90	830	34	4.09
II	1175	58	4.94	474	23	4.85
III	492	23	4.67	502	20	3.98
IV	2025	85	4.20	2073	80	3.85
V	919	40	4.35	805	30	3.72
Total	4995	221		4684	187	
Mean %			4.42			3.99

strengthened the conclusion that the bridges originated not through two independent breaks in a chromosome but largely as a result of a single break in an unsplit chromosome, caused by a single ionization track.

The sensitivity of the chromosomes of the primary spermatocyte resting cells of *Gesonula* to x-ray breakages does not alter appreciably for a relatively long period, inasmuch as Ray-Chaudhuri and Sarkar (*3*) have demonstrated the constancy of the frequency of first anaphase bridges recorded at different hours after irradiation up to a period of 148 hr. It is also likely that there is a similar stable period in the meiotic resting cells of plants. It has recently been shown by Darlington and LaCour (*5*) that in *Tradescantia bracteata* a constant frequency of first anaphase bridges is found between 16 and 48 hr after irradiation with x-rays. They, however, interpreted these bridges as originating from sister union of broken ends of chromatids (physiological effect) and not from chromosome breakage.

But the dicentric bridges in the meiotic cells of *Gesonula* are undoubtedly due to breakage in the chromosomes and not to any kind of physiological disturbance. This can be substantiated by the following evidence. An examination of the numerous bridges obtained by us during the course of our experiments reveals that the length of the dicentric portion of the chromatid between the two centromeres varies in different nuclei, in such wise that the length of the accompanying fragment (Fig. 2*a*, *m*) has a negative correlation with the length of the dicentric portion of the bridge (Fig. 2*a*, *l*). From the size of the monocentric free arms at the two ends of the bridge (Fig. 2*a*, *n*), we can get an idea about the size of the bivalent. A comparatively short dicentric portion relative to the size of the unaffected chromatid (free arm) indicates a break near the centromere. A bridge resulting from such a proximal break will be accompanied by a comparatively large fragment (Fig. 2*a–d*). On the other hand, the bridge originating from a distal break (Fig. 2*e–h*) will have a large dicentric portion and a small fragment. These conditions are always satisfied in all the bridges examined by us from this point of view.

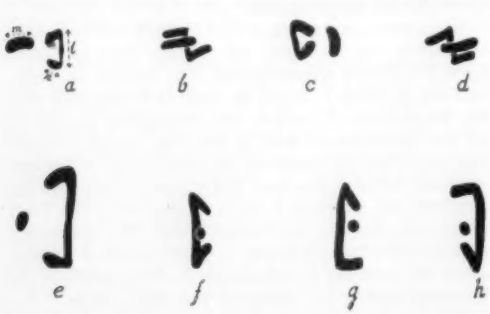

Fig. 2. *a–d*, dicentric bridges resulting from proximal breaks; *e–h*, bridges resulting from distal breaks.

References and Notes

1. B. P. Uvarov of the British Museum (Natural History) has recently informed us that the correct name for this species should be *Gesonula* (and not *Gesonia*) *punctifrons* as used by Ray-Chaudhuri and Manna (*2*) and Ray-Chaudhuri and Sarkar (*3*).
2. S. P. Ray-Chaudhuri and G. K. Manna, *J. Expt. Zool.* **114**, 421 (1950).
3. ——— and I. Sarkar, *Science*, **116**, 479 (1952).

4. We are deeply grateful to H. J. Muller, of Indiana University, for valuable suggestions incorporated in this paper. Thanks are also extended to S. Mitra, Director, Chittaranjan Cancer Hospital, for providing facilities for irradiation in his hospital and to A. Bose, physicist of the same hospital, for his help in arranging the irradiations.

5. C. D. Darlington and L. F. LaCour, *Heredity Suppl.* **6**, 41 (1952).

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Quantitative Flocculation of *S. schottmuelleri* Cells by Quaternary Ammonium Germicides[1]

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In recent years, relationships have been shown to exist between bactericidal properties and certain physico-chemical properties of quaternary ammonium germicides, for example, the release of conducting material by quaternary-treated cells (*1*) and the adsorption of quaternaries on wool (*2*). This report describes an attempt to relate bactericidal activities of quaternaries to the property of these agents of causing macroscopic flocculation of the test organisms. Clumping of bacteria as a result of the action of the quaternaries has been observed microscopically (*3*), but we are aware of no previous attempts to develop this observation into a macroscopic method for studying antibacterial action.

The addition of graded levels of quaternary germi-

[1] The opinions expressed herein are those of the authors and are not necessarily similar to the views of the Department of the Navy.

Table 1. Relationships between flocculation and bactericidal activities of three quaternaries.

Quaternaries*	Flocculation concentration†	Bactericidal concentration‡	Relative values	
			Flocculation values	Bactericidal activities
DAC	1: 2380	1: 21,000	1	1
ABC	1: 2050	1: 24,000	0.86	1.14
DBC	1: 1300	1: 17,000	0.55	0.81

* DAC = p-diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride; ABC = alkyl dimethyl benzyl ammonium chloride; DBC = dodecyl methyl benzyl ammonium chloride.

† All tubes contained 6.0 ml of washed *S. schottmuelleri* cells (Klett reading = 180), 0.75 ml of quaternary dilution and 0.75 ml of 1.0*M* NaCl. All tubes centrifuged 60 sec at 2200 rev/min on International Clinical Centrifuge to separate clumped cells and then read in Klett. The concentrations giving 50 percent flocculation of cells were arbitrarily selected as flocculation concentrations.

‡ Indicated concentrations kill in 10 min but not in 5.

cides, such as p-diisobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride, to a constant density of washed *S. schottmuelleri* cells suspended in NaCl solution gives gradations of flocculation that can be estimated visually or read turbidimetrically. Controls have repeatedly demonstrated that the flocculation is the result of a recation between the cells and the quaternary ammonium germicides. Thus far, no quantitative relationship between bactericidal activity, as determined by the phenol coefficient method, and the degree of flocculation has been established. Table 1 illustrates the bactericidal activities and flocculation values for three structurally different quaternaries.

Kivella, *et al.* (*3*) and Dyar and Ordal (*4*) have shown that strongly adsorbed quaternary germicides lower the electrophoretic mobilities of cells and ultimately reverse their negative charge. In the former work (*3*), clumping was demonstrated microscopically in the ranges giving positive mobilities. Flocculation as reported in the present paper occurs in the same range of concentrations. From these observations, it appears that the flocculation is an expression of the alteration of the charge at cell surfaces due to adsorption of quaternary germicide. Quaternaries of diverse chemical structure show differences in hydrophobic, polar, and other properties affecting adsorption (*5*); these differences in properties might result in the setting up of different zeta potenials at cell surfaces with dissimilar quaternaries, and flocculation might then occur at different levels of germicide, as shown in Table 1. From this, it would follow that the property being measured by the flocculation is the relative adsorption of the germicides, and since adsorption may be only a part of the bactericidal mechanism, it might not be unexpected that this flocculation test does not measure bactericidal activity. This would seem to be in contrast to the work cited in the first paragraph (*2*) in which a correlation between adsorption on an amphoteric material (wool) and bactericidal activity was indicated. However, close scrutiny of the data presented by these workers shows that the correlation is not quantitative.

Work is now in progress to determine other physical aspects of flocculation. Details on all findings will be published at another time.

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Experimental Dental Caries, IV. The Effect of Feeding Desiccated Thyroid and Thiouracil on Dental Caries in Rats[1]

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The most commonly accepted mechanism by which fluorine reduces dental caries is by means of ionic substitution of various components of the hydroxyapatite by fluorine during the calcification of the enamel. The result is the formation of enamel less soluble in the intraoral acids produced from ingested food. Unequivocal proof for such a mechanism, however, is lacking. Nevertheless, it is readily accepted that a marked diminution of salivary flow predisposes an increased incidence of dental caries. The corollary to this fact—that is, that a reduction in caries experience follows an increased salivary flow—also lacks experimental evidence but is an attractive hypothesis, since many investigators feel that caries resistance is associated with the ability of saliva to neutralize promptly intraoral acid formation.

Rathje (*1*) postulates further that the resistance to dental caries afforded by fluorine and the relationship of salivary flow to dental caries are intimately related. It is his opinion that the reduction in dental caries produced by fluorine may be mediated through the thyroid gland by increasing salivary flow. Other work also has indicated a relationship between the activity of fluorine and the thyroid gland.

When fluorides are given in conjunction with the thyroid hormone, they appear to accentuate the effect on basal metabolic rate normally produced by thyroid hormone alone (*2*). Also, evidence indicates that the thyroid hormone enhances the bleaching of rat incisors normally produced by fluorine (*3*). However, the relationship between altered metabolism and salivary flow

[1] This investigation was supported in part by the Medical Research and Development Board, Office of the Surgeon General, Department of the Army, under Contract No. DA-49-007-MD-332. Paper I in this series appeared in *J. Dental Research* **31**, 798 (1952); papers II and III are in press in *J. Dental Research*.

Table 1. Effect of fluorine, thiouracil, and desiccated thyroid on dental caries incidence in rats and the fluorine, calcium, and phosphorus levels in the skeleton.

Supplement	No. of animals	Dental caries experience		Skeletal analysis (ashed femur)			
		No. of lesions	Extent	F conc. (ppm)	Total F (mg)	Ca (mg %)	P (mg %)
Thyroid + F*	18	5.2 ± 0.31†	1.2	3619	1.115	39.2	14.5
Thyroid	18	6.5 ± .33	1.5	131	0.029	40.0	14.2
Thiouracil + F	32	10.0 ± .59	2.7	5662	.802	40.8	13.6
Thiouracil	33	10.1 ± .62	2.6	158	.030	38.9	14.3
Control + F	31	6.4 ± .45	1.5	3992	1.107	39.3	14.5
Control	29	7.6 ± .71	1.9	265	0.050	39.5	14.4

* 20 ppm F as NaF.
† Standard deviation.

has not been defined, although it seems clear that, with increased metabolism, one might expect a greater ability to create flow from the salivary gland. It is known that there is an increased oxygen consumption (*4*) in salivary glands with increased blood flow. Thus, since no previous work has been reported on any correlation between the thyroid gland and experimental dental caries, it seemed important to investigate whether any relationship exists between the dental caries experience in rats and the activity of this gland.

Approximately 175 rats of the Sprague-Dawley strain were divided into six experimental groups. One received desiccated thyroid in the diet (in increasing amounts from 10 to 60 mg per day per animal, depending upon the growth of the animal) and another received the same amount of desiccated thyroid plus 20 μg fluorine per milliliter (as NaF) in their drinking water. A third group received thiouracil (0.1 percent in the diet), while a fourth group received the same amount of thiouracil plus 20 μg fluorine per milliliter (as NaF) in the drinking water. Another group received the same concentration of fluorine in the drinking water, while the last group received no added supplement in either food or water and served as controls. All the animals received a stock cariogenic diet (*5*) and were on the experimental supplements for 145 days. At the termination of the experiment, the animals were sacrificed by chloroform inhalation, and the heads were removed for caries evaluation and the femurs for fluorine, calcium, and phosphorus analyses (*5*).

The animals receiving thiouracil failed to gain as much weight as the controls; the final weight gain was about 80 g less in the males and 60 g less in the females. The growth of the animals in the groups that received desiccated thyroid or sodium fluoride was not affected to any significant degree, and the administration of thyroid, thiouracil, or sodium fluoride at the concentration used in this experiment did not affect the calcification of the skeleton as judged by the amount of calcium and phosphorus in the femurs. These data appear in Table 1.

The skeletal-fluorine concentration, however, varied markedly. The data indicate that the thiouracil group receiving sodium fluoride had a higher concentration of fluorine than control animals given a similar fluorine concentration but not thiouracil. That thiouracil is related to this increased storage is strengthened by the fact that the group receiving thiouracil alone had a higher fluorine concentration than similar control animals not given thiouracil. Apparently, the desiccated thyroid was without marked effect in altering the fluorine storage in the skeleton, since the fluorine concentrations in both the thyroid and the thyroid-fluoride groups are essentially similar to their controls not receiving thyroid. This is further strengthened by noting the total fluorine in the femurs of the thyroid groups and their respective controls. In the thyroid-NaF group, there was approximately 1.12 mg of F, and in the control-NaF group 1.1 mg. However, while the highest fluorine concentration is found in the thiouracil-NaF group, the total fluorine was considerably less than in the control-NaF group. This further corroborates the fact that fluorine concentration is intimately associated with skeleton growth, since the thiouracil animals' final weight was less than the controls.

The results shown in Table 1 indicate that desiccated thyroid reduces the incidence of dental caries to the same degree as sodium fluoride alone, while desiccated thyroid plus fluorine reduces the caries experience by approximately 55 percent more than either desiccated thyroid or fluoride alone. This agrees with previous work indicating a synergism between the activity of fluorine and the thyroid gland (*2, 3*). When the activity of the thyroid gland was markedly decreased through the administration of thiouracil, the incidence of dental caries in the rat was decidedly increased. The addition of 20 ppm fluorine to the drinking water of animals receiving thiouracil, a quantity of fluorine that previous work has indicated to reduce caries by approximately 20 percent (*6*), was without effect on caries. The extent or size of the tooth destruction also parallels the number of lesions found in each respective group and further indicates that decreased thyroid activity is related to increased caries susceptibility in the rat. This evidence appears convincing that the activity of the thyroid is related

in some manner to the incidence of dental caries in the rat.

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Limitations of the "Zero Method" of Population Counts

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In counts of organisms per unit of area or substrate, such as are common in insect population surveys, if the distribution is fully random, numbers found will be expected to agree with the Poisson series. In practice, they usually show somewhat greater dispersion, with more zeros and high values than in a Poisson. The "negative binomial" often gives a fairly good fit to actual distributions. Sparse populations seem to diverge less than denser ones from the Poisson condition. I have discussed these situations (*1, 2*).

In a Poisson, the proportion of zeros or noninfested units is estimated as $e^{-\bar{x}}$, where $\bar{x}$ is the mean number per unit. This opens the way to estimation of the mean from the proportion not infested, as $\bar{x} = -\ln(q)$, where ln (q) is the natural logarithm of the proportion of zeros.

The method noted by Tippett (*3*) has occasionally been discussed or applied in entomology; Bowen (*4*) discusses it and some of its limitations. It is intended to save work, because it is easier to classify units as infested or noninfested than to count organisms per unit, although less information is gained. The relationship is used in bacterial estimation (*5, 6*) and in hemocytometer counting (*7*). Some of the articles referred to also discuss the additional use of proportion of ones, twos, . . . , which are readily deduced from the the Poisson expression for the expectation of x, $(e^{-\bar{x}} \cdot \bar{x}^x/x!)$. Such an extension of the method may be expected to increase accuracy at the expense of more work and to reduce the limitations of the method as compared with complete counts. Only the use of proportion of zeros will be considered here, however.

Samples from several sources have been studied. Bowen's leafhopper counts (unpublished reports) and some Mormon cricket egg counts have been studied briefly. The most comprehensive study, however, has been of a series of citrus rust mite counts from the Florida fruit insect laboratory of the U.S. Bureau of Entomology. In all cases, the method seemed rather disappointing. In low population densities, it was fairly accurate but did not save much work, since careful examination was needed before discarding a unit as noninfested. In dense populations, it saved work, because a unit could be discarded without further work as soon as it was found to be infested; but accuracy was lower. Furthermore, the method consistently underestimated the population.

The citrus rust mite counts used a unit ½ in. square, covered by a lens placed over the leaf to reveal the minute mites. A sample consisted of 75 such units, with counts as well as determination of percentage of units infested. These results are summarized in Table 1, which shows the limitations of the method very well.

Because of the definite indication of loss of precision at high density and of bias, an examination of the theoretical consequences of the relationship is undertaken. It will be carried out (i) for the case in which actual distribution conforms to the Poisson, and (ii) for the case in which it tends to the negative binomial.

Table 1. Rust-mite counts, relationship of proportion infested (p) and $\bar{x}$.

Range of proportion infested	No. of samples	Av. proportion	Av. no. per unit	No. expected from Poisson
0.0– 9.9	83	0.048	0.31	0.05
10.0–19.9	46	.144	.91	.15
20.0–29.9	48	.242	1.85	.28
30.0–39.9	25	.344	3.55	.42
40.0–49.9	15	.441	3.88	.52
50.0–59.9	11	.556	4.43	.81
60.0–69.9	16	.658	11.30	1.07
70.0–79.9	11	.736	13.04	1.33
80.0–89.9	5	.838	28.56	1.82
90.0–99.9	4	.933	30.00	2.70

As already stated, where the Poisson condition occurs, $q = e^{-\bar{x}}$, where q is the proportion of units not infested; and the relationship is employed in estimating the mean, $\bar{x}$. Obviously no serious *bias* is to be expected where the Poisson holds; but the *variance* of the estimate of $\bar{x}$ as $-\ln(q)$ needs examination. If $\bar{x} = -\ln(q)$, $d\bar{x}/dq = -1/q$. The variance of q is pq/n. The variance V of $\bar{x}$ as a function of q is estimated as $V_{\bar{x}} = Vq(d\bar{x}/dq)^2 = (pq/n)\ (1/q^2) = p/nq$. (This can be shown to be identical with a formula given by Eisenhart and Wilson.) The variance of X estimated by direct counts is $\bar{x}$; hence, the variance of $\bar{x}$ directly determined is $\bar{x}/n$. Thus, the comparison of variances of estimation through q and by direct count is of $\bar{x}/n$ with p/nq, or of $\bar{x}$ with p/q. It is quite evident that as p approaches 1, $\bar{x}$ will rise moderately and p/q will increase greatly. As q approaches 1, on the other hand, p and p/q will come nearer and nearer to $\bar{x}$, as nearly all infested units will be ones.

Thus, the loss of information in denser populations, in using the indirect method rather than the direct counts, is shown to be expected from mathematical theory.

Where populations tend toward a negative binomial form, as is often true with insects, serious *bias*, as well as higher variance, must be expected from the indirect estimation of $\bar{x}$. The negative binomial is more complex in its algebraic expression than the Poisson, the usual equation for fitting involving both mean and variance (*2*). Sufficient to show bias in the indirect method is the fact that the proportion of zeros is always higher for a given mean in the negative binomial than in the Poisson. Hence, estimation of the mean from the proportion of zeros, in negative binomial material mistakenly regarded as Poisson, will give too low a value. The expression $\bar{x} = -\ln(q)$ can readily be seen to have this tendency if q is higher than expected in proportion to $\bar{x}$. This will give a definite negative bias to such population estimates in many populations.

The tendencies that variance would show, if unbiased estimation of the mean from the proportion of zeros in negative binomial material could be carried out, may be studied briefly. The expression used for fitting the negative binomial is complex and does not lend itself to such a study. However, for selected levels of excess of variance over mean (for example, variance equal to twice the mean), the expression is simplified and can easily be shown to have the same tendencies as with the Poisson.

Thus, it is shown that in populations agreeing with the Poisson, the method of estimating mean density from the proportion of zeros loses much information at higher densities as compared with direct counts, although it is practically unbiased. With populations tending toward the negative binomial conditions, a strong bias also appears. These factors should be considered in appraising this method.

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Histochemistry of Ketoenolic Substances (Hamazaki)

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Ketoenolic substance was first demonstrated in 1934 (*1*) by Y. Hamazaki, who completed the ordinary morphologic research in 1938 (*2*). This substance was disclosed as fine granules in the normal cytoplasm and rarely in the nucleus in tissues treated with the special fixation and staining method described here. Whether or not any substance containing desoxyribonucleic acid exists in cytoplasm outside the nucleus of normal cells is still unknown both morphologically and chemically (*3*). Though the significance of this substance in the living organism is still unknown, it has a function almost similar to folic acid and, moreover, it can be a carrier of molecular oxygen. When any chronic disturbance of metabolism of this substance occurs, wear and tear pigments are formed (*4*).

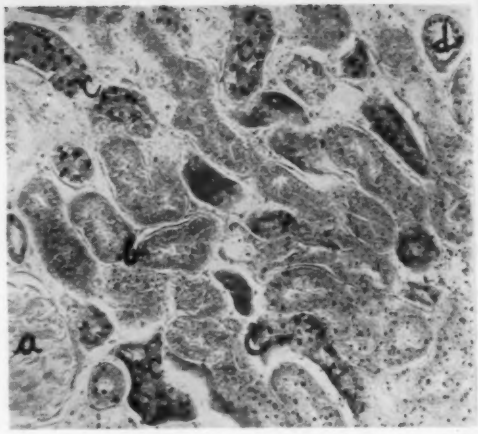

Fig. 1. Ketoenolic substance in the kidney of albino rat. Fixation with chromate mixture; carbol-fuchsin-iodine method. (*a*) Glomerulus; (*b*) proximal convoluted tubules; (*c*) intermediate portion; (*d*) intercalary portion.

For fixation, a chromate mixture originated by Hamazaki is applied; other fixation methods previously used were not successful. A mixture of 2.5 g of potassium bichromate, 1.0 g of sodium sulfate, 100.0 ml of distilled water, and 6.0 ml of glacial acetic acid is prepared, in which tissue is fixed for 48 hr. Paraffin or carbowax methods should be employed for making tissue sections. The carbol-fuchsin-iodine method invented by Hamazaki is applied as the staining method, because with other routine methods heretofore used the ketoenolic substance is not stained. Five-tenths gram of crystalline basic fuchsin is dissolved in 5.0 ml of absolute alcohol, into which 95 ml of 3-percent aqueous solution of carbolic acid is added. Tissue sections are stained in this solution for 1 hr and, after being washed in water, they are placed in 1-percent HCl for 10 min. After being washed in water, they are immersed in Lugol's solution for 30 min and later immersed in 1-percent sodium hyposulfite for 1 to 2 min to remove the iodine color. After being washed in water for several minutes, they are again placed in 3-percent HCl for 15 min. They are thoroughly washed in tap water, dehydrated with alcohol and xylol, and sealed with balsamum. This staining is a chemical color reaction.

When tissues are fixed with the chromate-mixture, the desoxypentose of nucleic acid is oxidized into ketone and then changed into enol, the OH of which reacts with fuchsin and iodine to produce a new kind of acidproof dye that is violet in color. Thus, the same

reaction can be produced by replenishing aceto-acetic ester or dehydro-gallic acid to desoxypentose nucleic acid. Noteworthy is the fact that this fixation solution causes desoxypentose nucleic acid to precipitate and pentose nucleic acid to melt (*5*).

Ketoenolic substance in a raw tissue is unstable, and when the tissue is immersed in water at 37°C for 1 hr the ketoenolic substance disappears. However, if it is immersed longer than this period, a degradation of nucleal desoxypentose nucleic acid occurs, because of autolysis, and a new kind of ketoenolic substance is produced (*6*).

Cold perchloric acid and trichloracetic acid will extract ketoenolic substances out of a raw tissue, but such is not the case with a tissue that has undergone the chromate-mixture fixation. However, when the extract is warmed, it is successful. When the carbol-fuchsin-iodine method is applied to an extracted tissue section and observed under a microscope, there can still be found a few large granules of violet color remaining in the tissue (Fig. 1). These are not ketoenolic substances but lipids. Since unsaturated fatty acids are especially well stained by this method, differentiation of lipase from ketoenolic substances can be made.

With regard to ferments, pepsin will not affect ketoenolic substances. Although the action of trypsin cannot be clearly ascertained, because the ketoenolic substances are dissolved by baryta water used in the preliminary procedure of trypsin digestion especially, the ketoenolic substances attached to the nuclear membrane or in the nucleus disappear.

The nucleotidase taken from beef liver digests these substances in a raw tissue, but action upon the tissue that has undergone the chromate-mixture fixation is difficult. Thus, unless it is drastically freed from fat beforehand, such action will not occur. With acid phosphatase that has been taken from a human prostate, similar action will be noted. Ribonuclease cannot make ketoenolic substances disappear from either a raw tissue or a fixed tissue.

Crystalline desoxyribonuclease (Worthington Chemical Laboratory) cannot digest ketoenolic substances. On this occasion, it is very interesting to note that a remarkably large amount of ketoenolic substances appear when the nucleotides are produced, owing to the degradation of the desoxyribonucleic acid in the nuclei. The Feulgen reaction proves negative to ketoenolic substances, while the improved Feulgen reaction (Hamazaki) (*2*) gives rise to a positive reaction. The reason for this is that, when hydrolysis is performed by warm HCl, ketoenolic substances are extracted (*7*).

When tissue was fixed with the chromate mixture, under a 2600-A ultraviolet-ray microphotograph, ketoenolic substances were found to be very absorbent. As previously mentioned, the ribonucleic acid extracted by this fixation has no part in absorption. When the carbol-fuchsin-iodine method is applied to the same section, violet-stained granules identical to the figure of absorption appear. These granules were not extracted by cold perchloric acid or digested by ribonuclease, but they disappeared by treatment with hot perchloric acid, and the absorption figures of ultraviolet rays totally disappeared.

The liver of a dog fixed by the chromate mixture was homogenized and extracted by 0.25-percent baryta water, which is an adequate solvent for ketoenolic substances. The extract underwent tests for ribose and desoxyribose by orcinol and cystein-sulfuric acid reactions, respectively. Not only were both reactions positive but the Feulgen reaction of the same extract was also slightly positive.

It can be concluded that Hamazaki's ketoenolic substance is a material that is chiefly made up of desoxyribose nucleotides (perhaps nucleosides mixed) which combine with certain lipids. Therefore, nucleic substances containing desoxyribose component can be demonstrated in cytoplasm outside of the nucleus.

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Exchange of Incompatibility Factors between the Nuclei of a Dikaryon

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Most of the Basidiomycetes have an obligate sexual union in their life-cycle. This sexual process is peculiar in that the cells of the fruiting-body do not contain diploid nuclei but pairs of haploid nuclei of complementary incompatibility types. The whole fruiting-body and a varying amount of mycelium represent a part of the life-cycle between plasmogamy and karyogamy, the latter occurring just before meiosis and the formation of basidiospores.

The two nuclei of a dikaryotic cell divide synchronously, and in most species this is accompanied by the formation of a clamp connection, which provides a useful indicator of dikaryotization. Dikaryons are normally formed whenever two monokaryons, or haploid mycelia, of appropriate incompatibility types meet.

In *Schizophyllum* and other Basidiomycetes the incompatibility type is determined by two series of incompatibility factors, the *A* series and the *B* series, individual factors of each series being designated by superscripts. For two monokaryons to be compatible, they must differ in both *A* and *B* factors. Thus, the matings $A^1B^1 \times A^1B^2$ or $A^1B^2 \times A^2B^1$ are compatible

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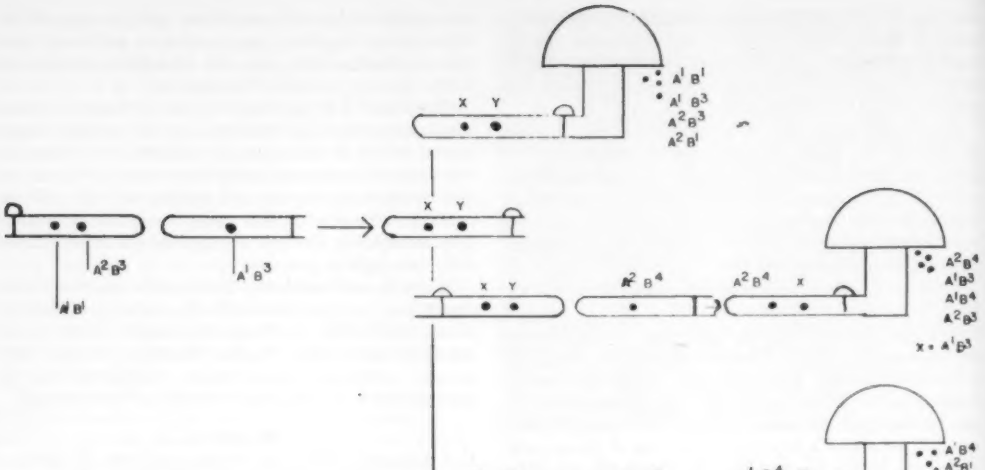

Fig. 1. Method used by Quintanilha to demonstrate formation of new nucleus. Arrows indicate diploidization; lines indicate subcultures. Symbols have been altered to conform with present usage. The fruit at the top indicates that no new mutant factors are present in X or Y.

and will form the dikaryons $A^1B^1 + A^3B^3$ and $A^1B^2 + A^2B^1$.

In 1931, A. H. R. Buller (*1*) described a phenomenon by which a monokaryon was dikaryotized by a dikaryon neither of whose nuclei were compatible with it.

In such non-compatible di-mon matings (*2*) where neither of the nuclei of the dikaryon is compatible with that of the monokaryon—for example, $(A^1B^1 + A^2B^2) \times A^1B^2$—there is evidence from two different experimental approaches (*2, 3*) that one of the nuclei of the newly formed dikaryon has an incompatibility factor derived from each of the nuclei of the old dikaryon.

Quintanilha's method (Fig. 1) involved the use of three incompatibility factors of the *B* series and relied upon the performance of two hemi-compatible di-mons, where one of the nuclei, X or Y, of the unknown dikaryon was expected to be compatible with the monokaryon. The factors present in the resulting dikaryon were found by allowing it to fruit. In Papazian's method, the composition of the unknown dikaryon was determined without forming fruiting-bodies by making use of the visible difference between noncompatible and hemi-compatible di-mons. In two out of 13 different combinations, there was evidence of an exchange of factors

A more satisfactory analysis could be made if the two nuclear components of a dikaryon could be separated. Such a separation would be easy in a species whose dikaryon produced homokaryotic oidia (*4*), but such an occurrence is apparently rare.

Microsurgical operations (*5–7*) have been used sucessfully, but they are very tedious and are ac-

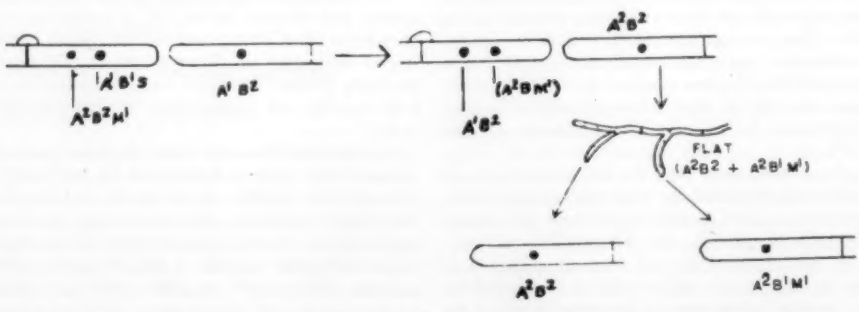

Fig. 2. Method of separation of components of a dikaryon by the use of "flat" heterokaryons.

companied by other complex phenomena. Prolonged blending in a Waring blender will also produce some portions of hyphae that grow into monokaryons, but the same objections apply here as do to microsurgical operations.

In *S. commune* another method has been devised; this relies upon the fact that two monokaryons that differ only in their *B* factors will form a peculiar heterokaryon called "flat," which is easily separated into its components by isolation of single hyphal tips. The formation of "flat" mycelia takes place also in noncompatible di-mons before the formation of the new dikaryon. Thus $A^1B^2 \times (A^1B^1 + A^2B^2)$ will give rise to a region of "flat" of constitution $A^1B^2 + A^1B^1$, and hyphal tips of the latter will give rise to two types of monokaryons, A^1B^2 and A^1B^1

Ten duplicates of the noncompatible di-mon ($A^1B^1s + A^2B^2m^1 \times A^1B^2$ were made. Streak (s) is a morphological mutant linked with the *A* incompatibility factor, and m^1 is a biochemical mutant, requiring uracil, unlinked to any other known factor. In six cases, a new dikaryon was formed on the A^1B^2 side of the mating, and this was then mated with an A^2B^2 monokaryon, $[(A^1B^1s + A^2B^2m^1) \times A^1B^2] \times A^2B^2$.

In all six cases, a region of "flat" developed. These were subcultured and ten single hyphae from each were mated with the tester strains A^1B^1, A^2B^2, A^1B^2, and A^2B^1.

In three cases, only A^2B^2 types were recovered, but in the other three, some of the single hyphae cultures gave all the reactions with the testers consistent with an incompatibility type A^2B^1; they were all $s+$ and m^1 (Fig. 2).

A monokaryon of type A^2B^1 had not entered into any of the crosses, and it is felt that this constitutes good evidence that the $A^2B^1m^1$ monokaryon had been formed by an interchange of genetic material between the nuclei of the original dikaryon ($A^1B^1s + A^2B^2m^1$). The *A* and streak factors remained in their parental combination; thus, there was no evidence for crossing over.

Although this phenomenon by which a nucleus of different incompatibility type is formed through exchange of factors between two nuclei in a vegetative hypha is not widely recognized (*8*), the evidence presented here should make it more acceptable. Unfortunately, little is known of the mechanism responsible.

Cytological studies have been made but proved unrewarding. Under phase contrast, the paired nuclei of the dikaryon in *Schizophyllum* can be seen very clearly. They consist of a large spindle-shaped outer membrane with a large dark sphere (nucleolus?) inside. During nuclear division, however, no mitotic apparatus can be seen. The dark spheres and the membrane disappear, and filamentous mitochondria concentrate in the region, but no metaphase chromosomes or spindle can be seen. Some 20 min later the daughter nuclei appear.

Work is now in progress with *Coprinus lagopus*, which appears to be a more suitable organism for such studies.

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Communications

Farmdale Drift

Recent field studies indicate that a portion of the glacial drift in northern Illinois formerly mapped as Illinoian is Farmdale in age, the earliest substage of the Wisconsin stage. The drift sheet consists of till and widespread deposits of water-laid materials in the form of kames, eskers, and kame terraces. So far as is known, this is the first reported occurrence of glacial drift of Farmdale age.

This drift is the uppermost drift in the northern half of Boone County, in all but small areas in southeastern and northwestern Winnebago County, in southeastern Stephenson County, in northern Ogle County, and in small areas in eastern Carroll and northern Whiteside counties. The loess (Peorian) cover which varies from a few inches to about 5 ft is usually leached.

Farmdale drift is recognized in auger borings and cuts to lie beneath discontinuous deposits of younger drift (Shelbyville and Bloomington?) in eastern Boone County; west, central and southern Ogle County; and eastern Whiteside County.

There are several indications that the drift is older than Iowan; the Farmdale loess [Leighton and Willman, *J. Geol.* **58**, 602 (1950)] which lies stratigraphically below Iowan drift is absent, although it occurs in the surrounding areas; the drift is more deeply weathered than Iowan drift at the same latitude in Iowa; the Farmdale drift passes beneath Shelbyville drift, which appears to be essentially contemporaneous with the Iowan of Iowa. [Shaffer, *Bull. Geol. Soc. Am.*, in press].

The Farmdale till differs markedly in color and texture from the younger tills that overlie it on the east, southeast, and south. Unaltered Farmdale till is usually light pink to salmon in color (7.5 YR 8/4 dry) and sandy textured. The color of the till resembles that of the Farmdale loess. The Farmdale till

contains a higher percentage of sand and a lower percentage of clay than the Shelbyville till.

A red-brown to rusty-brown leached zone is commonly developed on both ice-laid and water-laid deposits. Texturally, this material is clay-bound pebbly sand or clay-bound sand. Red-brown to rusty-brown staining in sand may be up to 11 ft thick (the deepest seen) but the clay-bound upper portion seldom exceeds 2 or 3 ft. Calcareous till or calcareous sand and gravel is frequently found within 4½ ft of the top of the leached till. Coarse-grained granite pebbles and cobbles are common, and an occasional basic pebble or cobble is present. The pebbles, cobbles, and boulders in the clay-bound zone are usually fresh or but slightly altered.

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Streamflow and Flood-Frequency Studies

The U.S. Geological Survey, in addition to its work of routine stream gaging, is at present conducting special investigations of streamflow under two major classifications. The first is a group of projects that may be classed together as low-flow investigations. The second is a nation-wide flood-frequency study.

About 10 yr ago, Federal agencies engaged in the collection or use of hydrologic data organized the Federal Inter-Agency River Basin Committee. The committee recognized that the most pressing need in hydrologic data was for information on small drainage areas. Since that time, a greatly intensified program of small-stream gaging has been carried on by the Survey. Drainage areas ranging in size down to less than 1 mi^2 are being measured. Small streams are so numerous that procedures are being developed for sampling and for selective measuring of important parts of the range in flow.

Knowledge of the low-flow portion of the streamflow record is highly important for many purposes, including farming, water supply, sewage disposal, and control of industrial waste. During periods of drouth and of the usually recurring low-flow periods, many discharge measurements are made within the affected areas. These measurements are being correlated with the records of long-term index stations where continuous records are obtained, in order to establish relationships allowing the prediction of low-water flow in general.

Knowledge of the high-flow portion of the flow regimen of small streams is needed for design of highway culverts, storm sewers, upstream flood-control works, and other purposes. In many places, peak flood measurements on small streams are being made whenever an outstanding flood occurs. One economical means of obtaining peak-stage records is by means of crest-stage gages, which automatically record the highest stage reached at some particular point on a stream and can be converted to peak-discharge records by means of discharge measurements. Records obtained by these means will supplement data already available on larger streams and will allow the development of flood-frequency curves through a wide range in drainage area.

The rational economic design of many structures such as bridges, levees, dams, or other structures on a floodplain requires a knowledge of the size of floods that may be expected and how often, on an average, floods of some particular magnitude will occur over a long period of time.

Engineers and hydrologists have been working for a long time on the problem of defining flood magnitude and frequency relationships. Peak-flood discharges are influenced by rainfall and by many complex and interrelated physical characteristics of the drainage basins involved. It is obvious that actual records of peak discharge represent an integration of all the factors, so that direct use of discharge records should give by far the best answer to magnitude-frequency relationships.

Techniques have recently been developed by the Survey for determining generalized flood-frequency relationships over wide regions. The method consists of two major parts: (i) the determination of the averages of the highest peaks that may be expected to occur each year at any point (known as the *mean annual flood*); (ii) the determination of dimensionless frequency curves that show the relationship in magnitude of a flood of any recurrence interval to the mean annual flood.

Some flood-frequency studies have been made on a state-wide basis. Reports for some states have already been published; others are being worked on. The ultimate objective is a nation-wide coverage, so that the magnitude of a flood of any frequency may be predicted with reasonable accuracy on any stream in the United States.

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Lysenkoism in Athens

Lysenko and his doctrines of genetics need neither introduction nor explanation. The Western World's geneticists have attacked and almost completely discredited all of his claims. Now we must take from him his last withering laurel sprigs, Original Hypotheses and Bold Guessing.

Already, when the Scythians and other barbarian tribes of proto-Russia were still slumped in savagery, Aristotle, Hippocrates, and Theophrastus to the south were proffering and testing the very ideas now called Lysenko's. The time, 350 B.C.; the place, Athens. We might compare some of those ancient Greek hypotheses with the modern Russian's claims.

Lysenko insists that he can "shatter" the heredity of an organism by placing it in a radically changed environment; thus, he says, he changes wheat from

one variety to another. Theophrastus, in his *Enquiry into Plants* (II, ii) stated that ". . . soil [at Philippi] seems to produce plants which resemble their parent . . . [but] a few kinds in some few places seem to undergo a change. . . ." And again, "If anyone were to plant our palm at Babylon it is reasonable to expect that it would become fruitful and like the palms of that country . . . for *the locality is more important* than cultivation and tendance." And a little further on (II, iv), he said, "[in growing plants] when a change of the required character occurs in the climatic conditions a *spontaneous change in the way of growth* ensues." And Aristotle seemed to say about the same, in essence, in his *Generation of Animals* (II, 4): ". . . foreign seeds produce plants varying in accordance with the country in which they are sown."

Recently Kihara and Sax [*J. Heredity* **44**, 132 (1953)] alluded to a new hope or dream uttered by Lysenko in a Chinese document. Lysenko and his followers hope to apply his "methods" to animal breeding and produce rapid and radical modifications there. In the absence of formal genetics, the Greeks thought of that too. Theophrastus had a 2300-yr jump on the Russian. With a straight face, the Greek philosopher wrote, " . . . so also changes in the nature of the ground produce changes in animals; for instance, the water snake changes into a viper, if the marshes are dried up." Considerable "shattering" of heredity was necessary in all of these cases, if true.

Lysenko claims that he can and did change one genus of cereal grain into another. Mendelian geneticists find no such possibility. The Greeks also thought of such changes, perhaps born of hope and desire. Theophrastus notes that "some say that *wheat has been known to be produced from barley,* and barley from wheat, or again both growing on the same stool." Then he hastens to protect himself with: "These accounts should be taken as fabulous." But on another occasion (II, iv) he wrote, without qualification, that "Wheat turns to darnel, one-seeded wheat and rice-wheat change into wheat," and then he adds the proviso, "*if bruised before they are sown* . . . in the third year." Lysenko apes this when he pretreats seeds to "shock" them into change.

The theory that acquired characteristics are transmitted to offspring, usually identified with Lamarck of the 18th century, has recently been "invented" by Lysenko. The gentlemen of the Lyceum were no strangers to that either. Listen to Aristotle (*History of Animals,* III, 12): "Some animals change the color of their hair with a change in their drinking water, for in some countries the same species of animal is found white in one district and black in another . . . and in Antandria there are two rivers of which one makes the lambs white and the other black." Hippocrates, in his *Airs, Waters, Places,* even constructs a theory to explain and support the idea. It was much like Darwin's Pangenesis and just as lacking in validity.

Those of Lysenko's "new" claims that are 23 centuries old can be enumerated as follows: (i) the "shattering" of heredity by sudden environmental change; (ii) the effective *pretreatment* of seeds of cereal grains to precipitate changes; (iii) the man-regulated *transmutation* of one genus of cereal grain into another; (iv) the quick *change of one genus of animal into another* by environmental control; and (v) the *transmission of acquired characteristics.* The Greeks asserted all of them provisionally.

The great thinkers at Athens may be excused, and even admired, for probing and postulating among the riddles of genetics; their reference libraries had not one datum to enlighten or guide them in that area. Lysenko has mountains of valid data, which he ignores. His claims are really all Greek to us.

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Bedrock Geology of the Montpelier Quadrangle, Vermont

The Montpelier quadrangle covers an area of about 213 mi² in the mountainous region of central Vermont east of the summit of the Green Mountains. The Worcester Mountains trend northeastward through the central part of this area. The Winooski River flows west-northwestward across the southern part of the quadrangle, between the city of Montpelier and the village of Waterbury.

The rocks of the quadrangle are in the east limb of the Green Mountain anticlinorium, whose axis nearly coincides with the north-northeast-trending summit ridge of the Green Mountains 3 to 6 mi west of the western border of the quadrangle. Bedded metamorphic rocks, originally sedimentary and volcanic, predominate. They include numerous intergradational rocks—chiefly quartz-sericite-chlorite schist, graphitic schist, and phyllite—and quartzite, greenstone, and interbedded quartzite and quartz-albite-sericite-chlorite granulite. These rocks, of Cambrian and Ordovician age, are overlain by interbedded slate, phyllite, and crystalline limestone probably of Silurian age.

Intrusive igneous rocks, which underlie less than 1 percent of the area, range in age from Ordovician probably to Mississippian. In the western part of the quadrangle serpentinite, possibly the oldest of these igneous rocks, is intruded chiefly into quartz-sericite-chlorite schist interbedded with greenstone. The serpentinite and its metamorphic alteration products—talc-carbonate rock and steatite—form tabular, lenticular, and pod-shaped masses that strike north-northeast and dip steeply in approximate parallelism with the schistosity and, commonly also, with the bedding of the enclosing rocks. Numerous sills and dikes of greenstone and chlorite schist, which are probably metamorphosed diabase, intrude interbedded quartzite and quartz-albite-sericite-chlorite granulite well east of the bodies of sepentinite. Sills of granite intrude

the interbedded slate, phyllite, and crystalline limestone in the extreme eastern part of the quadrangle. A few unmetamorphosed diabase dikes and sills have been found.

Metamorphic effects, probably of Devonian age, show in all rocks except the granite and the diabase. Most of the rocks in the quadrangle are in the low-grade metamorphic zone marked by the occurrence of chlorite, although a middle-grade zone with hornblende, almandite, and kyanite is centered in the Worcester Mountains. Metasomatic effects include porphyroblasts and quartz segregations and, on a larger scale, steatitization and carbonatization of serpentinite. Most of these effects are the expression of metamorphic differentiation, in which movement of material was confined to a few inches or at most a few feet; but some material, chiefly carbon dioxide, may have moved greater distances. Contact metamorphic effects, chiefly occurrences of cordierite and diopside, have been noted in the vicinity of the granite.

The principal folds in the region, including the Green Mountain anticlinorium, are probably of Devonian age. Most of the strata of the Montpelier quadrangle dip very steeply in the east limb of the Green Mountain anticlinorium, with the tops of the beds facing east; most of those in the southeastern half of the quadrangle are overturned to the east. A northeast-trending anticline centered in the Worcester Mountains is the most notable departure from the homoclinal structure. Minor structural features include schistosity, which is predominantly parallel or nearly parallel to the bedding, minor folds, most of which plunge very steeply, and lineation produced by fine crinkles parallel to the axes of the minor folds.

The leading mineral resource of the area of the Montpelier quadrangle is talc, an alternation product of serpentinite. It occurs nearly pure in steatite and mixed chiefly with the mineral magnesite in talc-carbonate rock. Other products derived from the bedrock include granite, now being quarried, and slate and copper, which have been recovered in the past.

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Fabric Studies of Gravelly Sediments: An Introduction to a New Sampling Procedure

Fabric, the spatial orientation of particles composing a solid, is an important characteristic or parameter of sediments that bears on genesis and post-depositional history. Orientation studies of large particles in sediments are of demonstrated value to research in sedimentation (*1*), but much work remains before diagnostic relationships between sedimentary fabrics and the processes that form and modify sediments are established. One approach, only partly realized, is the application of fabric characteristics of modern sediments to identification and genetic interpretation of older deposits.

Fuller application of orientation studies to the solution of sedimentary problems has been restricted by the labor and time required. Two general methods have been followed: (i) Direct measurement of linear elements of particles partly exposed in outcrop, generally by Brunton compass; (ii) marking of partly exposed particles in a way to permit subsequent reorientation and parameter measurements under laboratory conditions.

Direct measurement at the outcrop is a simpler, faster procedure and obviates preparation, transportation, and rehandling of bulky samples. The marking method, although more elaborate, offers distinct advantages in permitting more accurate and detailed evaluation of orientation elements. The apparent shape of a particle partly exposed in outcrop does not necessarily reflect its true shape. Direct measurement of such particles, therefore, introduces possible erroneous data, may result in an arbitrary selection of particles if sampling is not carefully done, and at best requires removal of each measured particle to ascertain whether the exposed portion is a true reflection of important shape characteristics. In contrast, the marking method involves no selection—except by size—thus eliminating much of the subjective element in sampling.

Karlstrom (*2*) describes improved equipment and techniques that facilitate sampling and analysis of marked particles from vertical cuts. A vertical orientation template is used for marking. A horizontal orientation template is readily devised which extends use of the marking method to the deposits that are more conveniently sampled from near-horizontal surfaces. The two templates are similar in principle and basic design. With the vertical orientation template, the marked lines are referred to a vertical plane in vertical and horizontal directions, whereas with the horizontal orientation template the lines are referred to a horizontal plane in N-S, E-W directions. In combination, the two templates can be used to sample exposures on all slopes intermediate between the horizontal and the vertical. Sampling with the horizontal orientation template applies most directly to fabric studies of such modern gravelly sediments as beach, alluvium, mud flow, lag gravel, outwash, and till; it is hoped that the procedure may stimulate increased use of fabric studies in these areas of research.

A simply designated horizontal orientation template consists of a slotted lucite plate, about 4 in. square and 0.5 in. thick, inset with a bull's-eye bubble level and compass. Slots, in the form of a cross, are cut just wide enough to permit insertion of a marking pencil. For marking, the template is leveled in position directly above the particle with the slots oriented N-S and E-W, and lines are drawn by guiding the marking pencil along the slots. Before removal from the outcrop, the lined particle is marked with an arrow to indicate its attitude relative to north.

To reorient after removal from outcrop, each marked particle is placed in a modeling-clay mount at the center of a horizontal circle to be used for

orientation measurements. A leveled transparent plate with two inscribed lines oriented N-S and E-W in accordance with the compass coordinates of the horizontal circle is placed over the mounted particle, which then is adjusted in its mount so that the lines on the particle coincide with the lines on the inscribed plate when viewed directly from above. Reorientation of particles by this method permits use of either the orientation goniometer for parameter measurements or other methods not requiring a goniometer (*2*). A convenient combination of inexpensive and readily available equipment consists of the inscribed transparent plate mounted on three legs, a large circle drawn on a horizontal surface, and an improvised clinometer or Brunton compass for measuring the parameters of reoriented particles.

Measurement of only two parameters, the long and short axes, precisely determines the attitude of a particle in space and is sufficient for most orientation studies (*3*). However, measurements of other parameters such as faces and surface markings, readily accomplished by the foregoing method, may significantly enlarge the scope and increase the accuracy of conclusions derived from the fabric studies of gravelly sediments.

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Helicopter Support for the Geologist

Geological fieldwork in Greenland has generally been curtailed by the difficulties of transport. Movement across country or along the coast has taken place mostly in spring and fall, when snow and ice conditions were favorable for sledging. However, the snow and ice that favor travel have an adverse effect on geologic observation, for they conceal much of the ground and limit observations to projecting outcrops. In summer, when the snow disappears and the details of the rocks are abundantly displayed, the geologist is faced with the necessity of back-packing across country or boating along the coast. In this season, he either is limited to an area close to his base or his observations are confined to only a few lines of traverse. The use of the helicopter for transport, however, has altered these conditions; and now the geologist can utilize the summer season for his fieldwork without the restrictions formerly imposed by lack of adequate transportation.

During the summer of 1953, several members of the U.S. Geological Survey and geologists from several colleges were requested by the Corps of Engineers and Transportation Corps, U.S. Army, to do fieldwork in northwestern Greenland in the vicinity of Thule. The area of interest was 650 mi² of hilly-to-mountainous terrain divided into two segments by a large glacier. The northern segment, consisting of 180 mi², was investigated by geologists operating from a single base camp, whereas surveys for the larger southern segment were carried out from a number of field camps as well as from a permanent base. The helicopters used were Bell H-13 Army-type, which proved to be well suited for such fieldwork. With a cruising range of about 140 mi, they were capable of carrying a geologist and pilot and about 400 lb of rock samples, or, for long trips, a corresponding load of additional gasoline.

In the northern part of the area, the helicopters were used primarily to carry the geologist between his base and his area of operations. In the southern segment, the helicopters were used in several ways. After the area close to the base had been covered on foot, the geologists and their equipment were transported to field camps, from which they traversed the surrounding country on foot, as in normal areal geologic mapping. This proved too slow, and as the summer advanced it was apparent that such a method would not permit the completion of the survey before the season drew to a close.

The use of helicopters was increased considerably in order to accomplish the work that remained. Aerial photos were examined and the ground patterns, which in a barren area such as Greenland directly reflect the mappable rock units, were outlined. Flight courses were established in order to cover each discernible unit and to cover the entire area systematically. The flight plans were used for organizing fieldwork and also provided a safety factor; if a helicopter was disabled, a search for it could be made more easily by following its flight pattern for the day.

For fieldwork, the helicopters were quickly flown to the area of interest, and at a height of 1500 to 2000 ft the general features of the terrain were observed. The helicopters then flew at altitudes of 10 to 200 ft above the ground at speeds of 10 to 40 mi/hr. At such low altitudes and slow speeds, it was possible to observe closely the characteristics of the material at the surface. Frequent landings were made at outcrops or where ground or photo patterns indicated a change. At all landings, samples were taken and the necessary geologic observations were made. In this manner, 30 to 60 mi² a day could be surveyed in detail equal to that obtained by traverse on foot.

The extreme versatility of the helicopter was demonstrated during periods of ground fog, which often persisted for a week at a time. During such weather, fieldwork with helicopters was possible, even though ground traverses were curtailed because features needed by the geologist to identify his position were obscured. The helicopters were able to rise above the fog and descend through openings in it, allowing the geologist to carry on the fieldwork. In extreme cases, it was practical to fly through fog at very slow speeds and very low altitude, using contact navigation to stay on course.

The cost of helicopter operation is high, about $100 per flying hour or about $400 a day per helicopter. However, where detailed areal geologic mapping is necessary, in an area such as northwestern Greenland, the over-all cost of using helicopters, considering the saving in time and effort, is about 80 percent of the cost of the same work accomplished by ordinary ground traverses.

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Book Reviews

Traité de Paléontologie. Vol. 3, ***Les Formes Ultimes d'Invertébrés; Morphologie et Evolution—Onychophores, Arthropodes, Echinodermes, Stomocordés.*** Jean Piveteau, Ed. Masson, Paris, 1953. 1064 pp. Illus. 9600 fr.; clothbound, 10,320 fr.

Volume 3 of this stately treatise completes coverage of the invertebrates. The remaining four volumes are to deal with the vertebrates. Twelve collaborators (11 French and one Belgian) contributed to this volume, which covers the arthropods, echinoderms, graptolites, and some minor groups. The arthropods take up half the book and the echinoderms a third.

The onychopora, merostomoids, pseudocrustacea, and marrellomorphs are dealt with by Colette Dechaseaux. These minor, but phylogentically important, groups are represented for the most part by Walcott's genera from his fabulous Middle Cambrian locality in British Columbia. The Scandinavian *Xenusion,* reported to be of pre-Cambrian age, is doubtfully referred to the onychopora (*Peripatus* and allies). If it is as old as it is alleged to be, it is perhaps the oldest recognizable form of multicellular animal life.

A chapter of 203 pages on trilobites is the work of Pierre Hupé. Somewhat more than half of it consists of a full and well-illustrated account of morphology, anatomy, development, habits, distribution, and evolution. The treatment of evolution is comprehensive, well-balanced, and restrained. The systematic part, however, gives the impression of having been hastily put together. It includes new superfamilies, many new families, and a great many new subfamilies. Supergeneric categories are diagnosed; genera are listed, with their age and general distribution. Genera are diagnosed in a publication by Hupé issued in 1953, and that publication contains a much more complete bibliography than this treatise.

The arthropleurids (protoarthropods of uncertain affinities), branchiopods, copepods, and crustacea of uncertain affinities are described by Dechaseaux; the ostracodes by Nicolas Grekoff; and the cirripeds by Henri and Geneviève Termier.

Daniel Laurentiaux contributed the chapters on myriapods and insects. The systematic part of his chapter on insects is a comprehensive survey of fossil insects. The chapters on merostomes, including the gigantostracea (a later name for eurypterids), and arachnids—a complete survey—are the work of Gérard Waterlot.

The echinoderms are very unevenly handled; the heterosteles and cystids are discussed by Lucien Cuénot, who died before the book was published. His treatment of the cystids stands out as the best for any of the major echinoderm classes. The blastoids are described by F. M. Bergounioux; edrioasteroids by Jean Piveteau; crinoids, stelleroids, and ophiocistioids by Georges Ubaghs; and echinoids by the Termiers. The systematic part of the chapter on crinoids is disappointingly and inadequately illustrated. It includes a new order, new suborders, and many new superfamilies.

Gérard Waterlot wrote the chapters on pterobranchs and graptolites, which are given class rank under Dawydoff's recently proposed phylum stomocords. The book closes with the Termiers' discussion of groups of uncertain affinities: machaeridians, conularids, hyoliths, and tentaculites.

The omission of any indication of the number of pages in publications cited in bibliographies appears to be a fixed policy of this treatise. The price is even higher than for Volume 1 or Volume 2.

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[1] I am indebted for advice to P. E. Cloud, Jr., and A. R. Palmer.

Chemie Lexikon, Vols. I and II. 3rd ed. Hermann Römpp. Franckh'sche Verlag, Stuttgart, 1952–53. 2108 pp. Illus. Clothbound, DM84—a vol.

To be successful, an encyclopedia must provide adequately detailed information on every topic coming within its survey, and yet remain both manageable in size and reasonable in cost. In a broad field such as chemistry, these aims are usually achieved by limiting the scope of the book to a particular section, and a number of excellent dictionaries and handbooks dealing with such limited areas of information have been produced. However, there is a need for an all-encompassing chemical encyclopedia to which the specialist may turn for information on other branches of his subject, and where the nonchemist may expect to find answers to any questions of a chemical nature. This need is adequately fulfilled by Dr. Römpp's *Chemie Lexikon.*

Special attention has been paid to the requirements of the businessman engaged in the chemical trade and to workers in industry. The scope of the book is so broad, however, that it will prove invaluable to all whose work brings them into contact with any branch

of chemistry, while the accuracy and completeness of the information provided are such that chemists themselves will find the book a useful addition to their reference libraries. Necessarily in a book of this scope, sections of information indispensable to one group of users will prove of little value to others. The inclusion of trade names may be invaluable for the industrialist but is scarcely warranted from the viewpoint of the researcher, considering the large amount of space that they require. Users in the latter group will, however, be pleased to find liberal references to reviews and texts where further information may be obtained, and frequently also to the original literature.

The third edition has been brought up to date (first volume to mid-1952, second to the end of 1952), and the additional information has been included without any increase in bulk over the preceding edition by resorting to the use of abbreviations. These, however, are not extensive and can be interpreted easily without repeated reference to the key provided. The excellent printing and format of the book remain unchanged, strict adherence to alphabetical listing of the items having been maintained. The encyclopedia is carefully cross-referenced, and location of the desired information is rapid and easy.

Although the coverage of less common chemical compounds is not as complete as in dictionaries and handbooks of more limited scope, *Chemie Lexikon* records a comprehensive range of substances related to all branches of chemistry and neighboring fields, such as foodstuffs, dyes, drugs, metallurgy, geology, and biology. Physical and chemical properties, preparative methods, uses, sources of supply, and in some cases prices are reported. Terms, reactions, theories, and laws are carefully explained. Information on modern chemical knowledge and practices, biographies of noted scientists, statistics on the chemical industry throughout the world, and a host of other subjects are covered. Descriptions of apparatus are usually accompanied by an illustration, and structural formulas of chemical compounds are given. The user with a limited knowledge of the German language will find no difficulty in understanding the clear and simple style of the author.

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Textbook of Physiology and Biochemistry. 2nd ed. George H. Bell, J. Norman Davidson, and Harold Scarborough. Livingstone, Edinburgh–London; Williams & Wilkins, Baltimore, Md., 1953. 1002 pp. Illus. + plates. $10.

This textbook first appeared in 1950 and has been well received in the British Isles, for whose medical and dental students it was written. Dr. Bell is professor of physiology in the University of St. Andrews, Dr. Davidson is professor of physiological chemistry in the University of Glasgow, and Dr. Scarborough is professor of medicine in the University of Wales. Coming from three different disciplines, these authors have produced a well-integrated volume, with a lucid style and straightforward argument, in which enough clinical material is incorporated to point the reader toward applications in the wards.

The second edition is somewhat longer than the first, but there has been little change in organization of the text and almost none in the illustrations. The figures are well chosen, many from classical sources, some newly drawn, and are reproduced with clarity, many appearing as halftones. References at the ends of chapters have been more than doubled, mainly by the inclusion of new papers and monographs published during the last 3 years. Nevertheless, the authors show a certain conservatism in their choice of material, and a number of recent advances have not been treated.

This book may be described as basically a text in physiology, with somewhat more than the usual attention paid to biochemistry. It is hardly adequate to serve the needs of the courses in biochemistry now given in American medical schools. It should be found acceptable as a text in some physiology courses, since the treatment is somewhat simpler than that used in most of the great tomes currently imposed upon American medical students, the majority of whom begin the study of the subject with very little background. The authors have certainly developed an interesting and easily read volume that should be helpful to many students, including seniors in arts and science schools who have had some previous training in the field.

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The Major Features of Evolution. George Gaylord Simpson. Columbia Univ. Press, New York, 1953. 434 pp. Illus. $7.50.

Dr. Simpson's new book is an outgrowth of his well-known earlier work, *Tempo and Mode in Evolution,* and contains the essential material of the earlier volume in a greatly expanded form. It is, therefore, the outstanding and, in fact, the only work that integrates the mass of paleontological data with the latest information from genetics to synthesize general principles about the course of evolution and the causal factors that underlie evolutionary change. For this reason, it should be on the must list for all scientists seriously interested in understanding evolution.

The book is built around the same basic topics as was *Tempo and Mode.* The same type of factual material is used for illustration—chiefly the fossil record of vertebrate animals, with some evidence from invertebrates. The data are again treated in a quantitative fashion, with statistical concepts playing a prominent role in the formulation of the general principles. The book is nevertheless free from statistical formulas and thus quite readable for those without much knowledge of statistics.

In this new work one finds a much larger body of factual material, and a fuller discussion of the ex-

amples presented. Some of these examples bring home Simpson's points with striking force; particularly illuminating is his analysis of changing evolutionary rates in the lungfishes, as deduced from the data of Westoll. Another improvement is the more logical arrangement of material. In *Tempo and Mode* there was a collection of ideas and facts about evolution only loosely connected with one another. The present work begins with a careful analysis of factual data on evolutionary rates, followed by a detailed consideration of the basis of variation, population, structure, selection, and adaptation and ends with a synthesis of the evidence presented in an account of evolutionary trends, chiefly on the level of the genus and higher categories. It thus builds up to the final climax in such a way that the reader becomes fully aware of the facts and reasoning back of Simpson's major conclusions.

The author devotes considerable space to discussing and refuting the arguments of those who disagree with the broad philosophy of evolution that he has adopted, namely, the Neo-Darwinian approach, which emphasizes selection of combinations of many small genetic differences as the dominant motivating force of evolution. The two opposing ideas that are attacked most persistently are the "mutationist" hypothesis, as presented by the geneticist Goldschmidt and the paleontologist Schindewolf, and the various versions of "orthogenesis," in the sense of evolutionary trends directed from within. The criticism of Schindewolf and Goldschmidt is based largely on different interpretations of the same paleontological data as those employed by Schindewolf, and in particular upon a more comprehensive and logical thread of argument. One example concerns the objection that the mutationists make to the Neo-Darwinian belief that higher categories, such as genera, families, and orders, arise through a continuation of the processes responsible for evolution on the level of species and subspecies. Both Goldschmidt and Schindewolf consider this unlikely, because the paleontological record shows that representatives of modern orders existed before organisms assigned to any modern family, and these in turn appeared before representatives of modern genera and species. Simpson points out the logical fallacy in this argument (p. 238):

> Now that the adaptive radiation is complete, we recognize the result as a family. . . . Looking backward from here, we consider that the family arose when its first species was differentiated. That species probably differed very little from its immediately ancestral species. . . . The family did not arise as such, but as a *species*. The family resulted from the whole radiation, and its first species is placed in it in retrospect.

On the subject of internally directed "orthogenesis," Simpson is equally logical and lucid. He illustrates the fact that the more we know about any particular fossil lineage, the more ramifications we find and the less it resembles a continuous series directed toward a single end-point. The evidence on the most famous of all fossil lineages, that of the horse, shows that it exhibits a large amount of irregularity and evolutionary opportunism. Many oft-repeated examples, that are supposed to demonstrate continued "orthogenesis" ending in the negation of selection and extinction owing to the inadaptive nature of the end-product, appear after Simpson's analysis, to be highly improbable or actually fictitious. Simpson proposes selectionist interpretations of such examples as the shellfish *Gryphaea*, the "Irish Elk" *Megaloceras*, and the labyrinthodont amphibians which are every bit as plausible as the nonselectionist, "orthogenetic" interpretations of these examples so often given in general books on evolution. One step forward made by Simpson is his emphasis on varying degrees of adaptation, and upon the fact that some species are broadly adapted and others narrowly adapted.

In the period between the writing of *Tempo and Mode* and that of the present book, Simpson has followed the recent trend of Neo-Darwinians in placing greater emphasis upon natural selection as the principal cause of evolutionary divergence, at the expense of such factors as drift and random fixation. The phenomenon of "quantum evolution," which he recognized in *Tempo and Mode* as a sequence of events responsible for the apparent sudden origin of many higher categories, was at that time believed to include an "inadaptive phase." In the present version, this phase is characterized merely as "narrowly adaptive," a concept more in keeping with evolutionary change as observed in living populations.

Although Simpson's viewpoint is basically Neo-Darwinian, he is not dogmatic or uncritical in maintaining this view. He recognizes the fact that the direction of mutation is not completely at random but depends upon the genetic and physiological nature of the organisms in which the mutations occur. The "randomness" of the mutational process exists only in relation to actual or potential adaptation to the external environment, or to any morphological trends that may be observed in the evolution of populations. In respect to the size of the effect produced by mutations, he cites several well-documented paleontological examples to show that certain changes of a major character appear to have evolved through the accumulation of many small mutational steps. He nevertheless recognizes the probability that single mutations with large effects have, from time to time, played an important role.

The style of writing in *The Major Features of Evolution* is in general far clearer than that of *Tempo and Mode*. The discussions in the earlier work were often so condensed that they had to be studied carefully before their meaning became clear. There are still some passages in the present work that are complex and somewhat obscure. These occur principally in the chapter on adaptation, where the reader is left with a feeling of the complexities of the adaptational processes in different organisms but without a clear concept of how they actually occur. Perhaps the greatest gap in modern evolutionary knowledge is our paucity of precise information on just how and why

certain characters are selected under a given set of environmental conditions. In any event, Simpson's numerous ideas deserve careful study by all scientists who wish to further our knowledge of evolution, either through the synthesis of available knowledge or through experiments designed and performed to increase this knowledge.

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Advances in Virus Research, Vol. I. Kenneth M. Smith and Max A. Lauffer, Eds. Academic Press, New York, 1953. 362 pp. Illus. $8.

It can hardly be said that this newcomer in the growing family of the "Advances" series fills any urgently felt need. Discussions of most areas of virus research have multiplied at a tremendous rate in the past few years, either as records of symposia or as reviews in various periodicals. Yet, *Advances in Virus Research* can make a real contribution by bringing together information from different areas of virology, and especially by encouraging the growth of the comparative approach.

The first volume contains generally sensible and occasionally authoritative material. What strikes the reader most forcibly is the uneven development of various areas. Epstein's opening article, a review limited to some well-known aspects of bacteriophage work, shows the enormous progress made possible by the use of strictly quantitative methods. Biological and biochemical aspects of phage research are, however, presented in a sketchy and somewhat confused manner. The two articles on plant viruses by Bennett and Black, both up-to-date and authoritative, serve to illustrate the urgent need for simple quantitative methods applicable to plant viruses. A host of challenging observations—for example, the joint transmission by insects of two viruses both needed for production of a disease—must await the availability of precise methods of study. The problem of "plant-and-insect" viruses, well presented by Black, is one of the most fascinating of biology and we must admire the patience and ingenuity required for work in this field.

The two papers that follow present an interesting contrast. Bergold's discussion of viruses that produce insect diseases shows, on the one hand, the need to complement the fine chemical and morphological observations (mainly the author's own) with precise work on virus growth and synthesis. Henle's article on influenza virus multiplication, a lengthy and somewhat overdetailed review, shows, on the other hand, the handicap of purely biological work on virus growth without close integration with biochemical analysis. It is almost inconceivable that even such basic information as the nucleic acid content and composition of influenza viruses should still be a matter of speculation.

"The focus of interest of this series [being] the virus, not the disease," as stated in the preface, Melnick's excellent review on poliomyelitis brings the reader a somewhat distressing realization of the primitive state of our knowledge concerning the biology and biochemistry of the agent of this most stubbornly investigated disease. Sharp's review of purification of animal viruses gives a useful compilation of recent advances in methodology. Markham's concluding article on nucleic acids, which unfortunately lacks the most recent information on desoxyribonucleic acid structure, is mainly valuable for the description of work on enzymatic degradation of ribonucleic acid.

As a whole this volume seems to suffer, not only from an apparent delay in publication, but also from the absence of an integrated plan. The suggestion might be made that the manuscripts for each future volume be submitted to a subeditor who, in an introductory article, would place the various contributions in some general perspective.

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An Introduction to the Theory of Seismology, ed. 2. K. E. Bullen. Cambridge Univ. Press, New York, 1954. 296 pp. Illus. $6.50.

Dr. Bullen has changed the text but very little in this revised edition. A comparison between the 1947 and the present editions shows that many pages are identical. This is not a criticism, however, but rather a compliment to the author. His original exposition has met the test of the critics, and although little new has been added to his *Introduction,* either edition is a "must" for the shelves of any geophysical library.

In his introductory chapter, the author treats the history of seismology in a concise manner but does introduce most of the major personalities and projects that pertain to the development of this science. He provides a logical plan for developing his text and then follows this plan closely and explains his points clearly.

In the chapters on elasticity and the wave theories of both body and surface waves, Bullen provides an excellent position. Although he busies himself with the major phenomena, these are explained and proved both clearly and comprehensively. These chapters comprise the best section of the book.

This book does not propose to be a directive on station operation, and a critic is always trying to change the purpose of the author when he makes suggestions. The reader learns very little about station operation from this work, and it does not explain sufficiently the operation or characteristics of various types of instruments. Again, the technique of locating epicenters, the interpretation of seismograms, and so forth, is not sufficiently explained. For the student the material presented is insufficient, and for the teacher the material is superfluous. In some places, the author's quest for brevity has resulted in his being too brief. In Chapter xv, for example, in treating Fur-

ther Topics, some dozen topics are mentioned in 10 pages and these cover the field from Effects of Earthquakes to Seismic Prospecting and Atomic Bombs. As a result, little is learned from such a hurried treatise.

The revised edition does contain a major change in the addition of a list of classified references. The list, although fairly well chosen, is by no means complete. Again, a reader would like something more comprehensive than has been offered. The section on Seismic Prospecting should mention the textbooks by Leet, Nettleton, Heiland, Jakowsky, Dobrin, Dix, and others. These are the most complete textbooks to be found in the English language for this classification of seismology. The references to articles in geophysical journals would number many more.

The book is well bound and the type is both attractive and clear. In general, it provides a handy reference book for a teacher, and parts of it, as mentioned earlier, represent a comprehensive exposé for the student.

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Les Groupes Sanguins Chez l'Homme: Etude Sérologique et Génétique. Jacques Ruffié. Masson, Paris, 1953, 207 pp. 1200 fr.

This new work is notable for its up-to-dateness and complete coverage of the field. It presents an admirable summary of the work of the last few years in blood grouping, yet manages to cover the salient historical facts also.

Starting with a general chapter, the author discusses successively the ABO system, the Lewis, MNS and PQ systems, the Rh system, and the Lutheran, Kell-Cellano, Duffy, Kidd, Jay, Vel, Levay, Jobbins, Graydon, Ven and Miltenberger factors and systems. Finally, a few pages (too few in the opinion of this reviewer) are devoted to the principles of probability.

The treatment of the ABO system is noteworthy for its coverage of recent discoveries and theories. Here one finds good accounts of the subgroups of A and AB, of the H antigen of Morgan, of Hirszfeld's theory of pleiades, the theory of Morgan and Watkins, and the new ABO blood group found in Bombay.

The treatment of the Rh system is outstanding. The immunological and genetical bases are stressed. The theories of Wiener and those of Fisher, and the Wiener and Race-Fisher notations are clearly presented and compared. The author is definitely in favor of the theory and notation of Fisher.

Although practically no mathematics is used, methods of calculation of gene frequencies are discussed, and nomograms are given for the calculations of the gene frequencies p and q and σ_D for the ABO system.

It is difficult to find vulnerable points to criticize. Probably because of the author's desire to be up to date, earlier work is often skimpily referred to or omitted entirely. For example, the fact that nomograms which do exactly what is claimed for those in this volume have been constructed by other workers and appear in a number of books (Hirszfeld, Schiff, and Boyd) is not mentioned. Also the book contains a number of misprints; fortunately they are for the most part amusing rather than serious. Thus the author Barbara E. Dodd masquerades through pages and pages as Dood. These are very minor flaws in an otherwise excellent treatise.

This volume serves as a very clear exposition of the present state of the rapidly expanding, subject of blood groups, very modern in outlook and bibliography, which should be useful to all who can read French.

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New Books

Le Mécanisme de la Vision des Couleurs: Physiologie—Pathologie. J. Segal. G. Doin, Paris, 1953. 351 pp. Illus. + colored plate. 3000 fr.

Great Systems of Yoga. Ernest Wood. Philosophical Library, New York, 1954. 168 pp. $3.50.

Metabolism of Steroid Hormones. Ralph I. Dorfman and Frank Ungar. Burgess, Minneapolis, Minn., 1953. 170 pp. Illus. $4.00.

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Formaldehyde. 2nd ed. American Chemical Society Monograph #120. J. Frederic Walker. Reinhold, New York, 1953. 575 pp. Illus. $12.00.

Physics: Principles and Applications. 2nd. ed. Henry Margenau, William W. Watson, and C. G. Montgomery. McGraw-Hill, New York–London, 1953. 814 pp. Illus. $7.50.

Modern Electroplating. Sponsored by the Electrochemical Society, Inc. Allen G. Gray, Ed. Wiley, New York; Chapman & Hall, London, 1953. 563 pp. Illus. $8.50.

Organic Chemistry. 2nd ed. Howard J. Lucas. American Book, New York, 1953. 726 pp. $7.00.

Prestressed Concrete. Y. Guyon. Edited by W. M. Johns; trans. by A. J. Harris, J. D. Harris, and T. O. Lazarides. Wiley, New York; Contractors Record, London, 1953. 543 pp. Illus. $12.00.

Clay Mineralogy. Ralph E. Grim. McGraw-Hill, New York–London, 1953. 384 pp. Illus. $9.00.

Enumeratio Spermatophytarum Japonicarum, Vol. II. A bibliographic enumeration of flowering plants indigenous to or long cultivated in Japan and its adjacent islands. Hiroshi Hara. Iwanami Shoten, Tokyo, 1952. 280 pp. + index of genera. 900 yen.

Tests and Standards for New and Nonofficial Remedies. The Chemical Laboratory, American Medical Association. Lippincott, Philadelphia–London, 1953. 327 pp. $4.00.

The Dawn of the Post-Modern Era. Dimensions of human life in the last half of the twentieth century. Elwyn Judson Trueblood. Philosophical Library, New York, 1954. 198 pp. $3.75.

Twenty-five Years of Sex Research. History of the National Research Council Committee for Research in Problems of Sex, 1922–1947. Sophie D. Aberle and George W. Corner. Saunders, Philadelphia–London, 1953. 248 pp.

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Population Problems and the American Eugenics Society

GROWING world concern with population problems gives special emphasis at this time to the significance of the American Eugenics Society. The position of eugenics today is fortified by such markers as the increasing interest in medical genetics, the formation of a eugenics section in the 1954 World Population Conference, the Pope's recent endorsement of positive eugenics, and the need to balance the concern over size of population with concern for the quality of that population.

For the first time, negative eugenics seems to be moving toward its goal with respect to the most severe diseases mainly due to heredity. The medical profession is increasingly interested in problems of medical genetics. The Eugenics Society is actively promoting publications and research in this field and the establishment of additional heredity clinics.

Even if all injurious mutations were destroyed immediately as they appeared, there would be no change at the upper levels of human activity. Improvement lies in changing the distribution of births among normal people, so that the proportion of children at the higher levels of normal capacity will be increased. This would raise the average level of the whole. The Engenics Society has developed a working hypothesis for advance in this field and is encouraging research to test the hypothesis.

The position of the Eugenics Society is that the largest families should be found not as a characteristic of particular races or social or economic groups but among all couples who give evidence of socially valuable qualities and a full acceptance of responsibility for their children. There can be no arbitrary decisions on who should and who should not have children. The parents alone must make the choice. The process of selection must come as the spontaneous response of individual couples to the pressures and aspirations of their environment. Recent American population studies have indicated certain favorable trends in this direction. Every economic and social change, every change in the psychological environment that tends to a better distribution of births will improve the environment and average genetic capacity of the next generation. The Eugenics Society is, therefore, working with leaders in the biological and social sciences, education, medicine, family life, and related fields.

In the past several years the Eugenics Society has been concerned with education as well as research. It has raised funds for a handbook on genetic defects for the practicing physician under the sponsorship of the New York Academy of Medicine. The society has made a grant for the formulation of plans for a major study of twins, to be in the hands of a joint committee of the National Research Council and the Social Science Research Council.

The publications program is expanding rapidly. A new journal, *Eugenics Quarterly*, was begun in March 1954. This is intended as a meeting ground for the geneticist, demographer, psychologist, and family-life consultant. Nearly 9000 pamphlets and reprints were distributed in 1953, and the demand for this material is increasing.

A joint symposium was conducted with the American Society of Human Genetics in Boston in conjunction with the 1953 AAAS meetings. Plans are also being formed to organize eugenics sections in some of the larger meetings of scientific and family-life groups.

The society is interested in strengthening its membership and inquiries should be addressed to the secretary.

FREDERICK OSBORN
Secretary

American Eugenics Society
230 Park Avenue, New York 17

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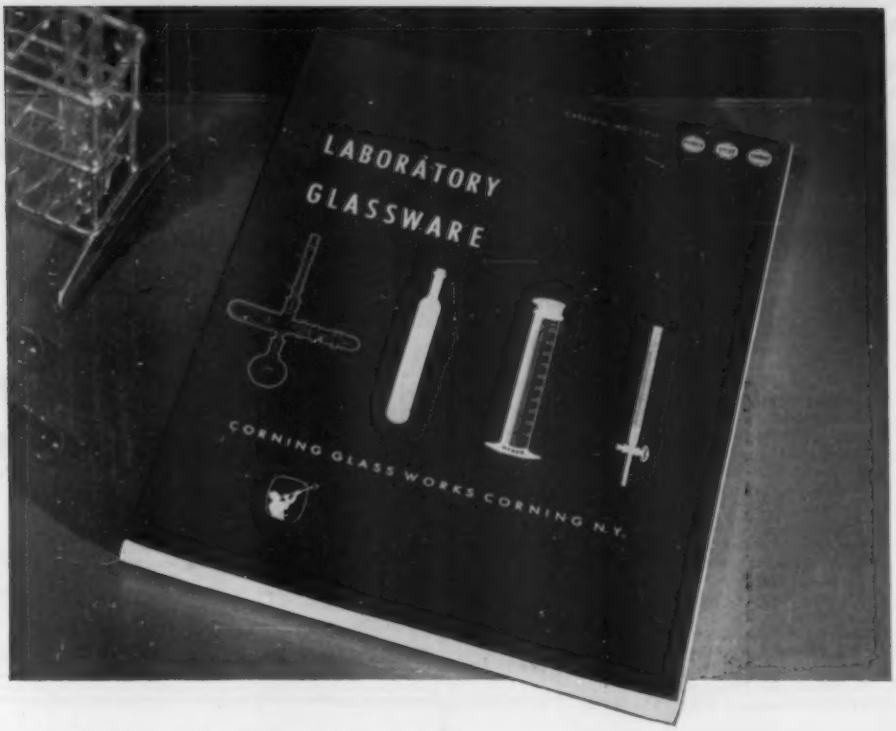

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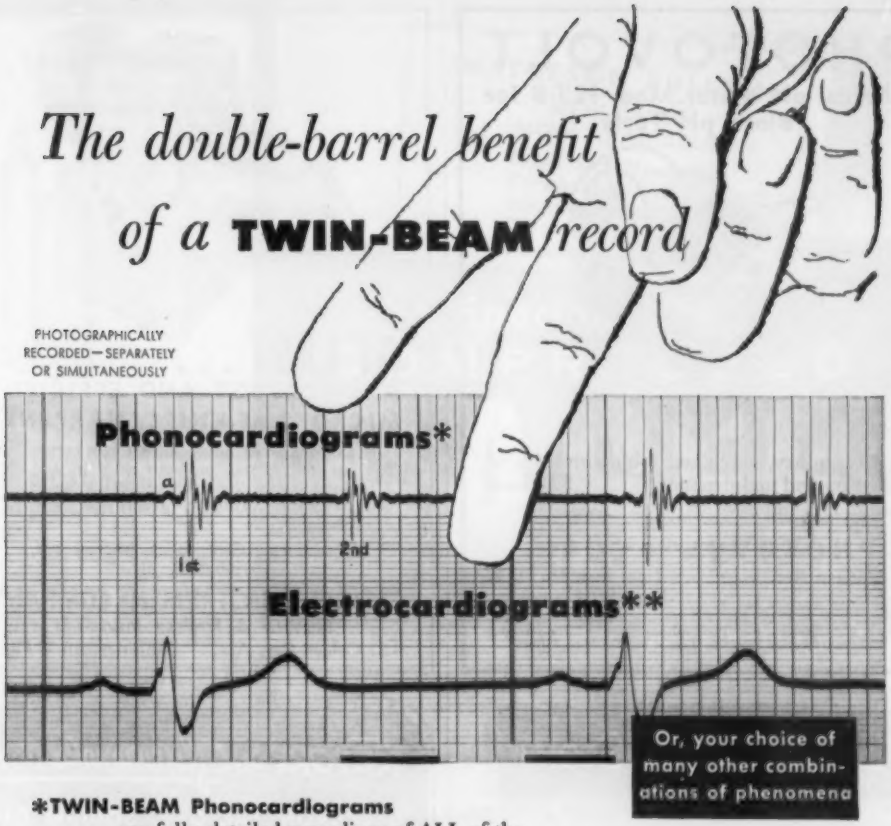

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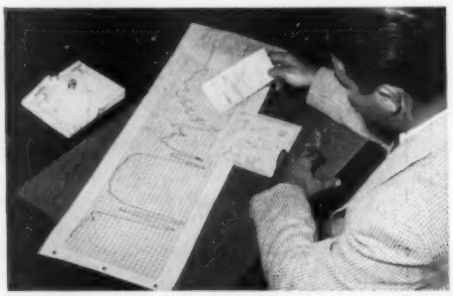

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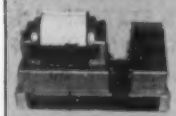

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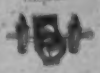

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Write for Product Bulletin A-3 for more information about these accessories.

Meetings & Conferences

June

15–18. Medical Library Assoc., Washington, D.C. (Col. F. B. Rogers, Armed Forces Medical Library, Washington 25.)

16–18. Symposium on Solution of Electrolytes, New Haven, Conn. (R. T. Gucker, Jr., Dept. of Chemistry, Indiana Univ., Bloomington.)

16–19. Colloquium of College Physicists, annual, Iowa City, Iowa. (G. W. Stewart, Dept. of Physics, State Univ. of Iowa, Iowa City.)

17–19. The Endocrine Soc., Sir Francis Drake Hotel, San Francisco, Calif.

18–19. American Rheumatism Assoc., annual, San Francisco, Calif. (W. H. Kammerer, 33 E. 61 St., New York 21.)

18–20. American Soc. for the Study of Sterility, Sir Francis Drake Hotel, San Francisco, Calif.

18–22. Canadian Medical Assoc., Vancouver, Can. (General Sec., 135 St. Clair Ave., West, Toronto 5.)

19–20. Soc. for Investigative Dermatology, San Francisco, Calif. (H. Beerman, 255 S. 17 St., Philadelphia 3, Pa.)

20–22. Conf. on Liquid Structure and Acoustics, Providence, R.I. (R. B. Lindsay, Dept. of Physics, Brown Univ., Providence.)

20–23. American Astronomical Soc., Ann Arbor, Mich. (C. M. Huffer, Washburn Observatory, Madison 6, Wis.)

20–23. American Soc. of Agricultural Engineers, annual, Minneapolis, Minn. (F. B. Lanham, ASAE, St. Joseph, Mich.)

20–24. American Soc. of Medical Technologists, Miami Beach, Fla. (R. Matthaei, Suite 25, Hermann Professional Bldg., Houston 25, Tex.)

20–25. American Inst. of Chemical Engineers, Ann Arbor, Mich. (D. L. Katz, Dept. of Chemical Engineering, Univ. of Michigan, Ann Arbor.)

20–25. American Soc. of Mechanical Engineers, semiannual, Pittsburgh, Pa. (C. E. Davies, 29 W. 39 St., New York.)

20–25. International Meeting on Chemical Engineering Aspects of Nuclear Processes, Ann Arbor, Mich. (D. L. Katz, Dept. of Chemical Engineering, Univ. of Michigan, Ann Arbor.)

20–26. American Library Assoc., annual, Minneapolis, Minn. (D. H. Clift, 50 E. Huron St., Chicago 11, Ill.)

20–10. National Training Laboratory in Group Development, Bethel, Me. (L. P. Bradford, 1201 16 St. NW, Washington 6, D.C.)

21–23. Chemical Inst. of Canada, 37th annual, Toronto, Can. (D. W. Emmerson, 18 Rideau St., Ottawa 2.)

21–24. Agricultural Inst. of Canada and Canadian Phytopathological Soc., annual, Macdonald College, Canada. (A. J. Skolko, Div. of Botany and Plant Pathology, Central Exptl. Farm, Ottawa, Ont.)

21–25. Alpha Chi Sigma Fraternity, annual, East Lansing, Mich. (J. R. Kuebler, 5503 E. Washington St., Indianapolis 19, Ind.)

21–25. American Inst. of Electrical Engineers, summer general and Pacific general, Los Angeles, Calif. (H. H. Henline, 33 W. 39 St., New York 18.)

21–25. Ecological Soc. of America, western section, Pullman, Wash. (J. W. Marr, Dept. of Biology, Univ. of Colorado, Boulder.)

(See the April 16th issue for summer meeting lists.)

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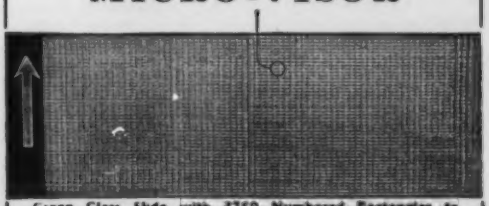

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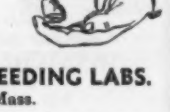

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